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Magnetic Drum Separator Performance Scalping Trommel Underflow at Nominal Design Conditions Test No. 4.01, Recovery 1, New Orleans

National Center for Resource Recovery, Inc.
Washington, DC

Prepared for

Municipal Environmental Research Lab.
Cincinnati, OH

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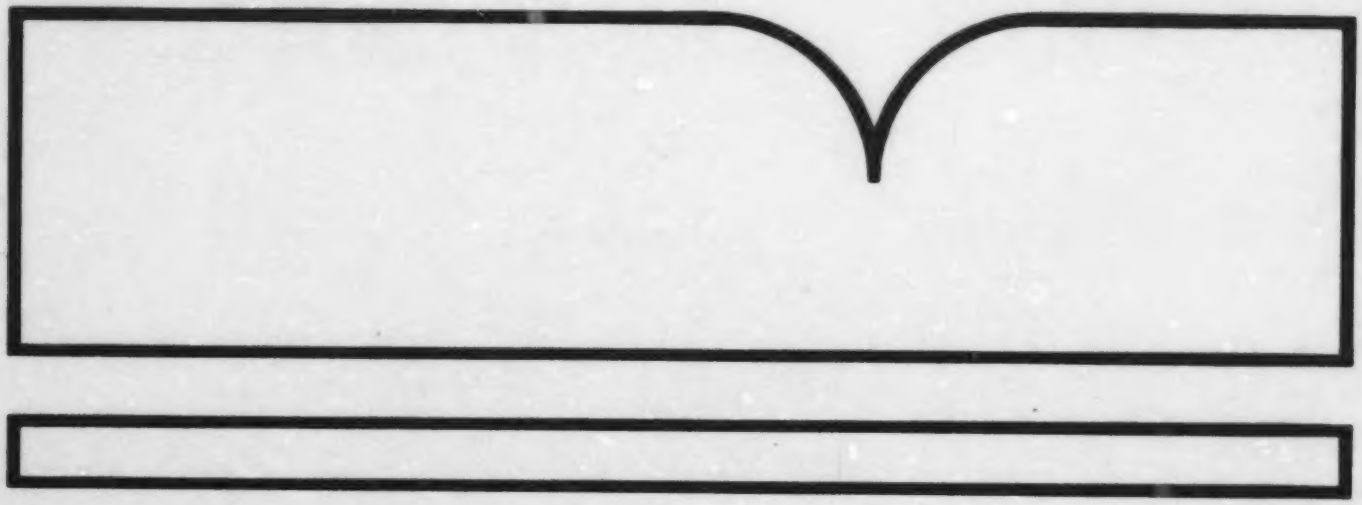

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MAGNETIC DRUM SEPARATOR PERFORMANCE SCALPING TROMMEL UNDERFLOW AT NOMINAL DESIGN CONDITIONS

Test No. 4.01, Recovery 1, New Orleans

by

National Center for Resource Recovery, Inc.
Washington, D. C. 20036

Contract No. 68-01-4423

Project Officer

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Solid and Hazardous Waste Research Division
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16. ABSTRACT

This report describes the first test (Test No. 4.01) of the magnetic drum separator that was designed to scalp the underflow of the trommel, or rotary screen, at the New Orleans, Louisiana, resource recovery facility (Recovery 1). The objective of the test was to document the performance of the trommel-unders magnetic drum separator with the trommel processing raw municipal solid waste at the nominal design feed rate of 62.5 tph.

Three replicate test runs were conducted at the nominal design feed rate to the trommel. For each test run, the two output streams of the magnetic drum separator, magnetics product and scalped trommel unders, were collected, then analyzed for bulk density and magnetics content, air-dry moisture loss, composition, particle size distribution, and contamination. The percent of magnetics recovered from the feed, by magnetics component, was determined. Additionally, samples of trommel unders were analyzed for total moisture content.

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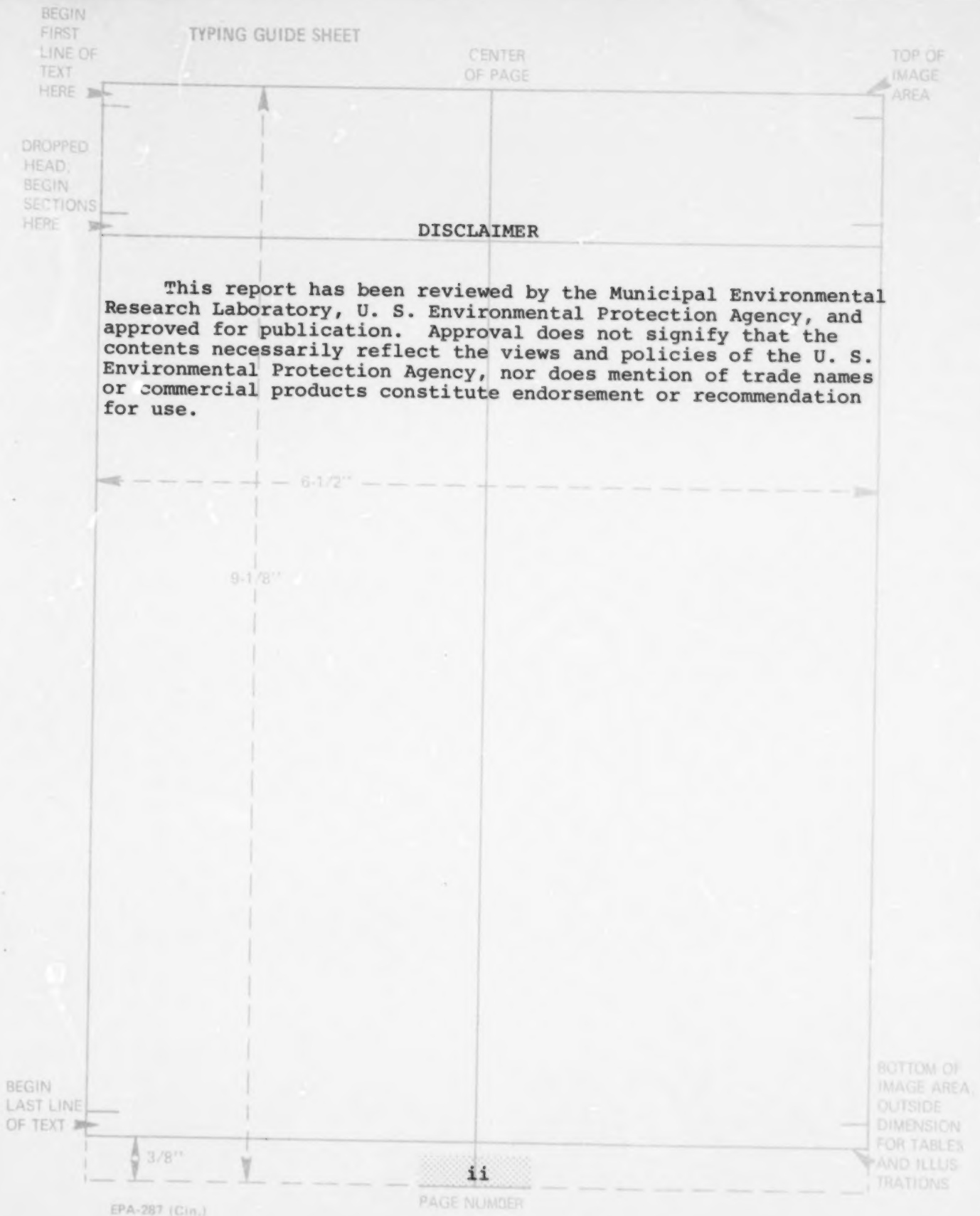

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FOREWORD

The Environmental Protection Agency was created because of increasing public and government concern about the dangers of pollution to the health and welfare of the American people. Noxious air, foul water, and spoiled land are tragic testimony to the deterioration of our natural environment. The complexity of that environment and the interplay between its components require a concentrated and integrated attack on the problem.

Research and development is that necessary first step in problem solution, and it involves defining the problem, measuring its impact, and searching for solutions. The Municipal Environmental Research Laboratory develops new and improved technology and systems for the prevention, treatment, and management of wastewater and solid and hazardous waste pollutant discharges from municipal and community sources, for the preservation and treatment of public drinking water supplies, and to minimize the adverse economic, social, health, and aesthetic effects of pollution. This publication is one of the products of that research; a most vital communications link between the researcher and the user community.

This report documents a performance test, at nominal design conditions, of the magnetic drum separator scalping the trommel underflow at the New Orleans resource recovery project, Recovery 1. Trommel processing of municipal solid waste concentrates magnetic material in the trommel underflow, thereby facilitating the recovery of magnetics by a single magnetic drum separator. It is hoped that this report yields data useful to those considering use of trommels and magnetic drum separators at materials and energy recovery plants.

Francis T. Mayo, Director
Municipal Environmental Research Laboratory

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Three replicate test runs were conducted at the nominal design feed rate to the trommel. For each test run, the two output streams of the magnetic drum separator, magnetics product and scalped trommel unders, were collected, then analyzed for bulk density and magnetics content, air-dry moisture loss, composition, particle-size distribution, and contamination. The percent of magnetics recovered from the feed, by magnetics component, was determined. Additionally, samples of trommel unders were analyzed for total moisture content.

The report details the results of the test and describes the magnetic drum separator, its associated equipment, and test and analytical procedures used.

This report was submitted in partial fulfillment of Contract No. 68-01-4423 by the National Center for Resource Recovery, Inc., under the sponsorship of the U. S. Environmental Protection Agency. This report covers a period from September 20, 1978, to October 20, 1978; data analysis and reporting were completed as of July 1979.

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CONTENTS

Foreword iii
Abstract iv
Figures. vi
Tables vi
Acknowledgments. vii

1. Introduction and Summary of Test Results 1
2. Equipment Description, Test Description, and Sample Processing 9
   - Equipment Description 9
   - Test Description. 12
   - Sample Processing 17
3. Test Results 20
   - Nomenclature. 20
   - Magnet Efficiency: Three Runs Taken Together 21
   - Comparison of Data Among Runs 28

English to Metric Conversion 33
References 34
Appendices

A. Magnetics Sorting Categories 35
B. Test Data. 37

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FIGURES

Number		Page
1	Schematic of Recovery 1 processing through magnetics recovery	2
2	Trifurcated chute (No. 173.1)	10
3	Trommel unders MDS (#170) and ancillary equipment	11
4	Sectional view of type "LD" magnetic drum	13
5	Gauss pattern of MDS (#170) at 14 amperes	14

6-1/2"

TABLES

1	MDS (#170) As-Designed vs As-Tested Operating Parameters and Performance	15
2	Data for Moisture Samples	17
3	Sample Data	
	A. Composition of Feed	22
	B. Composition of Product	23
	C. Composition of Tailings	24
4	Magnet Efficiency	25
5	Ferrous Opportunity and Product	26
6	Composition: Size Distribution and Ferrous Type, Composite of Three Runs	27
7	Contamination in Percent	28
8	Magnet Efficiency by Run	29
9	Magnet Efficiency	30
10	Comparison of Data Among Runs	30
11	Ferrous Distribution in Percent	31

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The cooperation of Recovery 1, the Waste Management, Inc., company, Mr. Norbert J. Bolda, Recovery 1 General Manager, and of the City of New Orleans Department of Sanitation, Mr. Patrick J. Koloski, Director, is gratefully acknowledged. Our thanks also go to Raytheon Service Company, Mr. Michael R. Grubbs, Manager, Systems Development, for the loan of the testing screen used in this work, and to Stearns Magnetics, Inc., Mr. Mario R. Palazzari, Customer Service Manager, for furnishing characteristics of the magnetic drum separator tested.

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SECTION 1

INTRODUCTION AND SUMMARY OF TEST RESULTS

Separation or extraction of magnetic material from municipal solid waste (MSW) is widely practiced [1]. At Recovery 1, there are two primary magnets, as there are two material streams containing magnetics (see Figure 1). The function of one magnet is to remove ferrous from that portion of the MSW that has passed through the 4-3/4" diameter circular openings in the trommel.* This material is known as the trommel underflow, and the magnet, the trommel underflow magnet. The other magnet is for ferrous recovery from the shredded trommel overflow. This is material that does not pass through the trommel holes. After being discharged from the end of the trommel, it is conveyed to a shredder, where such portions of it as are oversized are reduced to a nominal 90% by weight -4", after which it passes under the second magnet. The subject of this Test Report is the performance of the first magnet, i.e., the trommel underflow magnet. A subsequent report will describe the performance of the second magnet, which magnetically scalps the shredded trommel overs.

Figure 1 shows the components of the ferrous recovery system. The magnets are of the revolving drum type. They are suspended over the head pulleys of the trommel underflow and trommel overflow conveyors. Drum magnets were selected because they appeared to offer an acceptable recovery efficiency, yet were less expensive to purchase than other types of magnet separators. Operating costs were also expected to be lower than the alternatives considered [2].

Note that the ferrous removed by both magnets is subject to a cleanup step. The objective of this step is twofold: (1) to separate light-gauge ferrous (mainly cans) from heavier-gauge, i.e., non-can ferrous; and (2) to pneumatically remove contamination (paper, plastics, etc.) carried over at the time the ferrous was extracted from the waste stream. When the system was installed, it was not expected that entrapped organics or composite products (items where steel and an organic component are physically joined, as a plastic-bodied oil can)

*A metric conversion table is provided at the end of the text.

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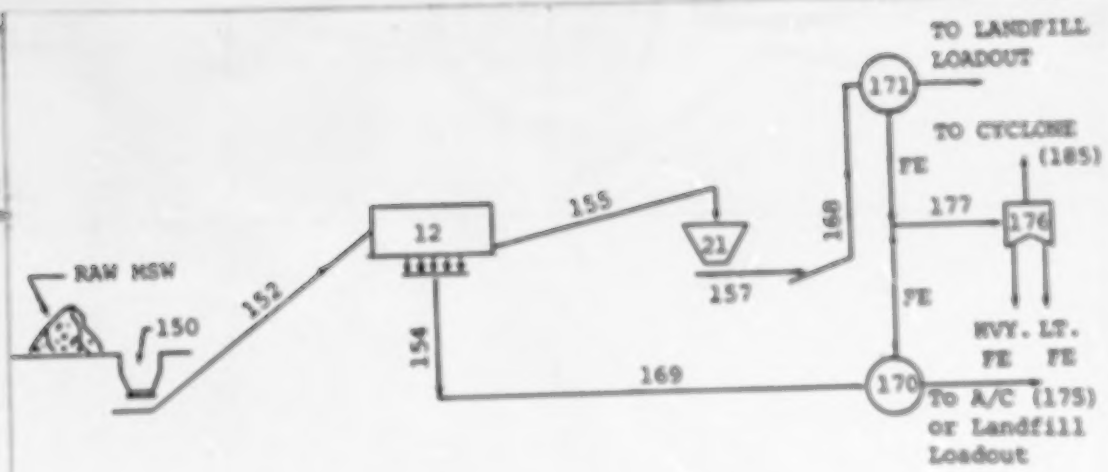

EQUIP. NO.	DESCRIPTION
12	TROMMEL
21	HEIL SHREDDER
150	PIT NO. 1 CONVEYOR
152	TROMMEL INFEED CONVEYOR
154	TROMMEL UNDERS DISCHARGE CONVEYOR
155	TROMMEL OVERS DISCHARGE/ HEIL SHREDDER INFEED CONVEYOR
157	HEIL SHREDDER DISCHARGE CONVEYOR
168	SHREDDED TROMMEL OVERS MDS FEED CONVEYOR
160	TROMMEL UNDERS MDS FEED CONVEYOR
170	TROMMEL UNDERS MDS
171	SHREDDED TROMMEL OVERS MDS
175	TROMMEL UNDERS AIR CLASSIFIER
176	FERROUS CONCENTRATOR
177	FERROUS CONCENTRATOR FEED CONVEYOR

Figure 1. Schematic of Recovery 1 processing through magnetics recovery.

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would cause difficulty in meeting market specifications. This assumption has turned out to be erroneous, as will be documented here.

During the last year and a half, the focus has been on the recovery of the light-gauge magnetics, as it has proven possible to sell this material, while the heavier magnetics have not found a buyer. Therefore, this Test Report highlights the efficiency of the trommel underflow magnet as a light-gauge ferrous separator. In this regard, taking average values over three timed runs, the magnet showed an efficiency of 87.4% measured on an as-received basis. As-received counts contamination. The 87.6% figure is the weight of the light-gauge magnetic material recovered, including its entrapped contamination, divided by the weight of the contaminated light magnetics in the feed.* Another meaningful statistic is magnet efficiency on a clean-metal basis. This is 92.3% for the light metal. The clean metal figure is based on analysis performed in the laboratory where the contamination was removed by washing, scraping, etc. For example, in the heavy metal category, the ceramic portions of spark plugs were broken off and the metal that remained weighed separately.

Magnet product also included some heavy, i.e., noncan-related, magnetics with their entrapped contamination and some loose contamination. According to the test results, for every 100 lbs of magnet product, 65-1/4 lbs is the desired light-gauge ferrous, 22-1/4 lbs is heavy ferrous, 2 lbs is loose contamination, 9-1/4 lbs is entrapped contamination (light ferrous), and 1-1/4 lbs is entrapped contamination (heavy ferrous). From this, it can be seen that, even if the subsequent unit processes in the ferrous recovery system worked perfectly, i.e., removed all the free contamination and the heavy ferrous with its entrapped contamination, the light ferrous product would still amount to 65-1/4 lbs of metal and 9-1/4 lbs of entrapped contamination. This amount of contamination, almost 12-1/2%, is unacceptable.** It is expensive to ship, and it confounds the processing equipment and the detinning units of the buyer. For this reason, an equipment modification is currently underway to shred the ferrous concentrate, after which a second magnetic scalp will be accomplished.***

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*As computed, it is the as-received light magnet product divided by the sum of the as-received light magnet product plus the as-received missed light magnetics in the tailings.

**Measured on a percent of total basis (9-1/4 divided by (65-1/4 + 9-1/4). On a clean metal basis, it is slightly over 14% (9-1/4 divided by 64-1/3).

***In actual practice, loose contamination cleanup and the heavy/light classification are not done perfectly. Not all of

In the present configuration, the data show that the trommel underflow magnet would produce approximately 17-1/2 tons of magnetic metal per day, measured on a clean-metal basis. This assumes that 650 tons of refuse are processed at the nominal 62.5 tph feedrate. Of this clean ferrous product, just under 13 tons would be the desired light ferrous metal, and roughly 4-1/2 tons heavy ferrous, i.e., non-can material. In addition to the ferrous metal, the magnet product would also contain about 2 tons of entrapped contamination and 1/4 ton of loose contaminants. Counting contamination, both loose and entrapped, the total product from the trommel underflow magnet would be approximately 19-3/4 tons per day.

The tin-plated steel food can is the greatest contributor to ferrous recovery.* The principal reason is that these cans make up the bulk of the magnetics in the feedstock (40% on a clean-metal basis). Bimetal beverage cans are 17% of the feedstock (also on a clean-metal basis).**

Recovery efficiency for the two types of containers, based on clean metal, is 98% for the food cans and 96% for the bimetal beverage cans. In terms of the magnet product, 44% by weight of clean metal is food cans and 18% bimetal beverage cans. Because of the larger amount of entrapped contaminants in the food cans, their proportion of the magnet product, measured on an air-dried basis, rises to 45%, while that of the bimetal can falls to 17%.*** The average contamination on an air-dried basis of the food cans in the magnet product was 10%; contamination of the bimetal beverage cans was slightly less than 2%.

---

the loose contaminants are blown off. Also, some light ferrous is lost to the heavy rejects and some heavy ferrous reports to the marketed product. Finally, the trommel overflow magnet is generally on and the system is run at higher throughput than measured in the test. The net result is that the marketed product generally has a composition of about 1% loose contaminant, 15% heavy ferrous with about 0.5% entrapped or physically bound contamination, and 74% light ferrous with about 9% entrapped contamination. The total contamination is about 10%. These data were developed from samples taken on site.

*Magnetic sorting categories are shown in Appendix A.

**There is little effect on the percentage composition for these categories when contamination is taken into account (see Section 3).

***Before sorting into the various categories, the as-received material was air-dried in a warm ventilated room for six days. Overall weight loss was just under 4% during this

The most significant size range is -4" +2". In the feedstock, on a clean metal basis, this size range accounted for 72% of the magnetic opportunities by weight. On an air-dried basis, the -4" +2" fraction was also 72%, since the entrapped contamination percentage was essentially the same as the feed as a whole. For the magnet product, the -4" +2" size range contributed 77% by weight on both a clean-metal and air-dried basis. Of the -4" +2" magnetic material in the magnet product, food cans make up 53% (clean metal) and 55% (air dried); bimetal beverage cans, 24% (clean metal) and 22% (air dried).

Entrapped contamination is given particular attention throughout this report. As mentioned, entrapped, by the definition used here, also includes physically joined, as in the case of a motor oil or orange juice can with steel ends and a nonmagnetic body. The market specification advanced by the buyer of the light-gauge magnetic product from Recovery 1 is 4% nonmagnetic. Contamination of product, in terms of this specification, includes the aluminum ends of bimetal cans, inasmuch as they are shredded off by the buyer's processing on receipt at his site. Note, however, that in all the data developed here the attached aluminum end is not considered a contaminant, but is included in the clean magnetic totals.

The magnet acts as a cleanup device itself, since it differentially attracts magnetics as a function of their contamination. There was a significant difference between the contamination of the ferrous material, particularly the light-gauge ferrous that was extracted by the magnet as product compared to the entrapped contamination in the missed magnetics. For example, while the average entrapped contamination in the -4" +2" size range of the feedstock was 14% by weight, the magnetics in this size range in the product exhibited only an average of 8% entrapped contamination. The contamination level of the -4" +2" rejects was over 68%.*

Of the light-gauge ferrous constituents of the feed, the composite cans were the most heavily contaminated (71%). Fortunately, the composite cans comprised less than 4% (air-dried basis) of the light-gauge magnetics and few were recovered.

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period. As-received weights are only available for the total sample. Estimates of the as-received weights have been developed for the two subcategories, light and heavy, but for reasons of loss of accuracy this estimation is not applied to subcategories (see Section 3).

*Measured on an air-dried basis, of 100 lbs of -4" +2" magnet rejects, 68 lbs was entrapped contamination.

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The data indicate that, as far as composite cans and contaminated food cans are concerned, an object that is less than one-third magnetic metal will probably not be extracted by the magnet. It would have been useful to have been able to determine more exactly the level of entrapped contamination at which extraction for various types of magnetic constituents would be effected. Does a food can with 25% entrapped contamination report to product or is it missed? Unfortunately, the test was not conducted with this analysis in mind; therefore, data for this parameter will have to await further testing.

The data given above resulted from the averaging of three test runs of 15 seconds each. Because of the high throughput rates involved, even a run of only 15 seconds involves 340 lbs of feedstock and splits into 324 lbs of tailings and 16 lbs of product. Ninety linear feet of belt are involved. The volume of material is 20-2/3 ft^3 of feed and 1-1/4 ft^3 of product.

In conducting a test of the sort described here where the average of the runs is offered as a descriptor of equipment performance, it is desirable to have as many operating parameters as possible the same for each run; for example, the same amount of material scanned by the magnet during the 15 seconds of each test run. To this end, an attempt was made to run the system at its nominal design capacity of a trommel feedrate of 62.5 tph, with the same weight of material fed to the trommel for each run. The speed of the pit conveyor was constant throughout. However, the amount seen by the magnet during any increment of time can be affected by inadvertent uneven loading of the pit conveyor and, more importantly, by variation in the bulk density of the particular batch of refuse. Also, the amount of material that appears on either the trommel overflow or underflow belt, even if the feed rate is the same among runs, is affected by the well-known heterogeneity of the refuse itself. For example, a single large piece of corrugated box material masking a number of trommel holes changes screening efficiency. If this happens at the time interval associated with the short-duration test, the run would not be representative. In spite of all of this, the amount of material passing the magnet during each of the three tests was within ±15% of the mean.

For any given magnet field strength, performance is a function of inter alia, the size, weight, aspect, level of contamination, placement of the magnetic material, the burden depth of the waste from which the magnetics have to be extracted, the density of the refuse on the belt, and the speed of the belt. Again, ideally, it would be desirable for each of these parameters to have been the same for each test run. The feed conveyor belt speed was constant throughout, as was the placement of the magnet in relation to the belt. However, there

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was a difference in the magnet's field strength between Run 1 and Runs 2 and 3, with Run 1 having a 6% higher strength than Runs 2 and 3. Interestingly, and contrary to what one might expect, the efficiency of the magnet was higher in Runs 2 and 3 than in Run 1. On an as-received basis, magnet efficiency was 81.2% for Run 1, 83.4% for Run 2, and 85.4% for Run 3. On a clean-metal basis, the corresponding figures were 87.8%, 90.0%, and 93.3%.

The lower Run 1 magnet efficiency was probably caused by the fact that the flow rate for Run 1 was higher (by 22%) than the average for the other two runs. The burden depth was essentially the same among the three runs. Hence, the bulk density for Run 1 was also 22% higher than the other runs. The higher density may have impeded extraction of the magnetics.

Total moisture of the feed to the magnet varied inversely with the bulk density and mass feedrate among the three runs, which may reflect changes in the composition and/or particle-size distribution of the nonmagnetic material in the feed among the three runs. For example, an increase in glass composition would likely increase the trommel unders bulk density and decrease total moisture. This is offered as an explanation for the decreased efficiency during Run 1, even through the magnet's strength was higher.

An analysis of the opportunity for ferrous extraction among runs (i.e., the amount, composition, and proportion by size range in the feed) shows that there were some differences. First, there was a difference in the amount of ferrous present. Estimated on an as-received basis, the ferrous percentage by weight in Run 3 was 6.1%, Run 1 was 5.4%, and Run 2 was 4.9%. Because of differences in entrapped contamination among runs, they group more closely measured on a clean-metal basis: Run 1 (4.6%), Run 2 (4.1%), and Run 3 (4.9%).

As far as size distribution is concerned on an air-dried basis, on average, 72% of the magnetics were in the -4" +2" range, and there was only a +6% -6% variation from the mean among runs. This is important since, as has been mentioned, the magnet is most efficient when operating on ferrous in this size range. There was a difference among runs in the amount of food cans present in the feedstock, ranging from 43% (air-dried) in Run 1 to a low of 35% in Run 3. Also, the entrapped contamination of the food cans was more than twice as great (16% against 7%) in Run 3 as for Run 2. Both of these factors would suggest that Run 3 would have exhibited a lower extraction efficiency than the other runs. However, contrary to this expectation, as has been mentioned, Run 3 was the most productive, with 85.4% recovery as against 82.0% for Run 1 and 83.4% for Run 2 on an as-received basis. Compensating factors must have been at work,

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one of which probably is the fact that, as discussed above, Run 3 had the largest relative amount of ferrous material (6.1% on an as-received basis), compared to the other two runs (Run 1, 5.4%; Run 2, 4.9%).

The data developed from this test is not extensive enough to differentiate rigorously among the causes of the measured variation among runs. Generalizatons based on only three test runs are risky in themselves. More runs, larger samples, and additional types of measurement would be needed to go beyond the modest objectives of this test program. However, it appears that the three runs can be fairly considered samples from the same population, and hence their average can be viewed as a fair representation of the performance of the trommel underflow magnet. However, no information was gathered as to the placement of the individual pieces of magnetic material in the mass of the trommel underflow and their aspect with relation to the magnet. It is not known if these factors which presumably influence magnet performance were essentially the same among runs. To have found out is simply beyond the scope, including financial resources, available to this investigation. Therefore, although this is probably the most extensive report made to date on magnetic separation from MSW, the data presented here are still only an initial look at magnet performance which, along with the initial results, documents how the tests were conducted, may have been conducted better, and points out where additional research is needed.

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SECTION 2

EQUIPMENT DESCRIPTION, TEST DESCRIPTION, AND SAMPLE PROCESSING

EQUIPMENT DESCRIPTION

Figure 1 showed the various unit processes involved prior to the magnets and used in the further processing of the magnetic product. In normal operation, a front-end loader places municipal solid waste (MSW) from the tipping floor of the Receiving Building into the conveyor system, which feeds the refuse into the trommel. As previously discussed, that portion of the MSW that does not pass through the 4-3/4" diameter holes of the trommel exits the discharge end of the trommel barrel. This overflow is then shredded. The portion of the MSW that passes through the trommel holes (trommel unders) falls onto a 5' wide horizontal troughed-belt conveyor (#154). Conveyor #154 travels at 118 fpm and transfers the trommel underflow onto an inclined troughed-belt conveyor (#169) oriented at 90° to #154's direction of travel as viewed from above. Conveyor #169 serves as the feed conveyor to the trommel underflow MDS (#170).

Both the trommel underflow magnet (#170) and shredded material magnet (#171) are positioned at the headpulleys of conveyors #169 and #168, respectively, atop a trifurcated chute (#173.1), as shown in Figure 2. The function of the trifurcated chute is to control the flow of the tailings between the landfill-loadout area and the air classifier [2]. Both magnetic drum separators and their common product conveyor (#177) are totally enclosed (not shown). The magnet product is transferred by conveyor #177 for further processing.

The trommel underflow feed conveyor (#169) is approximately 120' long and is inclined at 17.6° above the horizontal. Its 3-1/2' wide belt is troughed by three equal-roll troughing idlers (5" diameter x 15" long rolls). The 24" diameter x 44" long stainless-steel head pulley has a 3/8" thick rubber sheath vulcanized to its surface, on which a 3/8" thick conveyor belt rolls. The conveyor is driven at 360 fpm by a 7.5 hp electric motor, and has a design capacity of 37 tph for 6- to 10-lb/ft^3 bulk density material. The spatial arrangement of feed conveyor #169 and MDS #170 is shown in Figure 3. As can be seen from Figure 3, the centerline of conveyor #169 is offset from the

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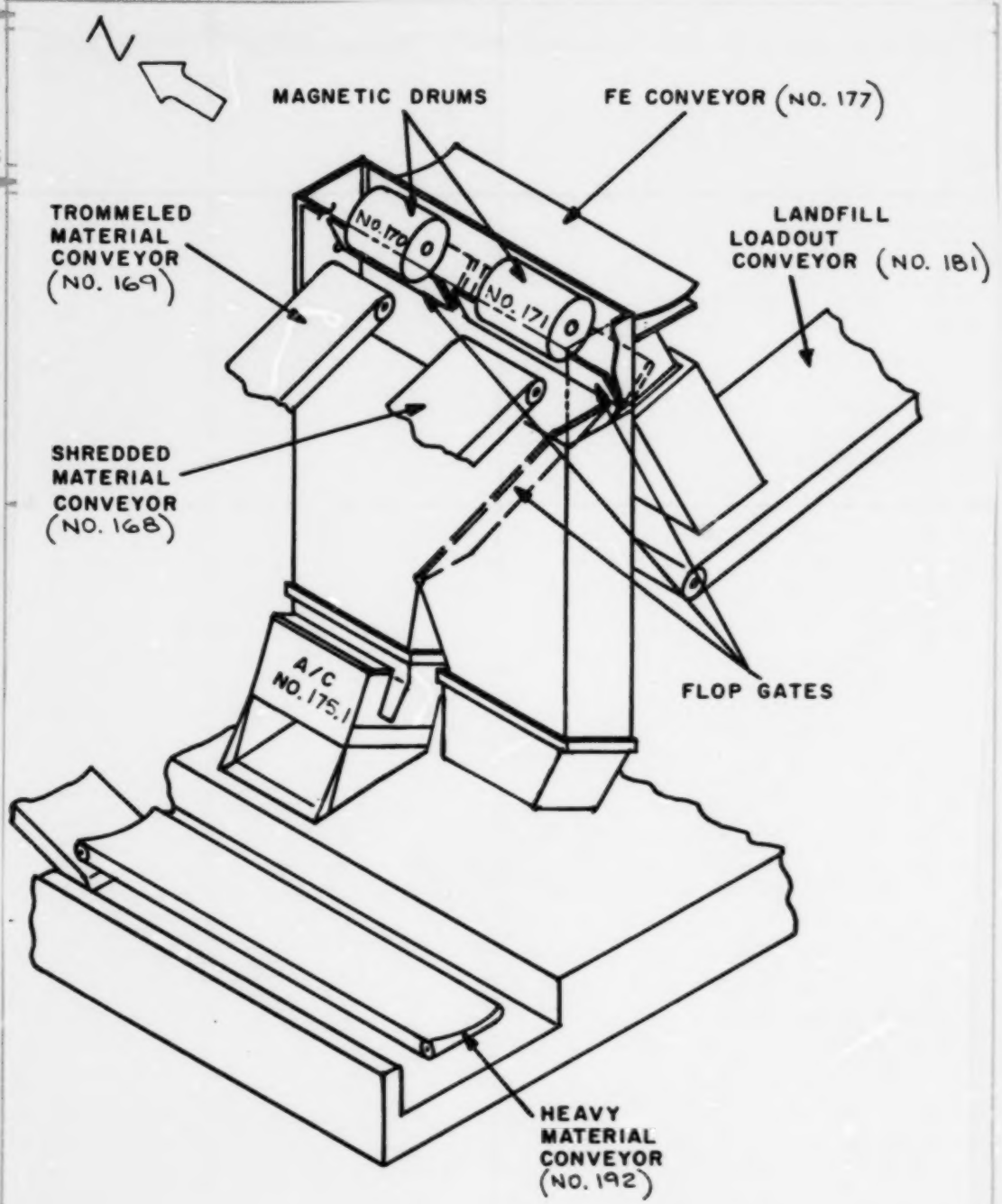

Figure 2. Trifurcated chute (No. 173.1).

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Figure 3. Trommel unders MDS (#170) and ancillary equipment.

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centerline of the drum by 5-7/8". Since the maximum magnetic strength occurs along the centerline of the drum, the maximum magnetic strength at the conveyor belt surface is necessarily offset. This is compensated for by a similar offset in placement of the burden on the feed conveyor (#169).

The trommel underflow magnet (#170) is an electromagnetic type "LD" Model 104 LT drum (42" diameter x 54" long), manufactured by Stearns Magnetics, Inc. It consists of an electromagnet assembly (coil and pole pieces) mounted on a support shaft inside an outer rotating cylinder (see Figure 4).

The outer rotating cylinder is constructed of 3/8" thick manganese steel. The cylinder has eight cleats or "sweeps" attached radially at 45° intervals. Every other sweep has 45°-angled attached ends (see Figure 3). The drum is rotated at 28.3 rpm by a 5 hp motor. The magnet assembly position, although stationary during operation, may be adjusted within limits. The electromagnet coil is powered by direct current (DC) supplied by a rectifier rated for 5,200 watts at 230 VDC.

The "gauss pattern," or lines of constant magnetic strength at distances from the drum face for #170, is shown in Figure 5. The data for the pattern were gathered by Stearns Magnetics before shipment of MDS #170 to Recovery 1.

The operating parameters and performance of the #170 magnet as-designed and as-tested are presented in Table 1. The principal difference is in the air gap between the MDS drum and feed conveyor belt surfaces. The larger air gap as-tested resulted in a lower magnetic strength (flux density) at the feed conveyor surface, which would reduce the recovery of magnetic material if all else were the same. Other appreciable differences between as-tested and as-designed operating parameters were: higher-than-design bulk density of feed material and the previously mentioned offset in the centerlines of the feed conveyor and the MDS drum.

TEST DESCRIPTION

The test procedure followed for the test runs is outlined below.

(1) A known quantity of MSW was placed uniformly to tipping-floor level in Pit No. 1

(2) Pit No. 1 conveyor (#150) was set to feed 62.5 tph into the trommel: Pit No. 1 conveyor (#150) speed = infeed rate/(MSW weight/length covered on conveyor #150).

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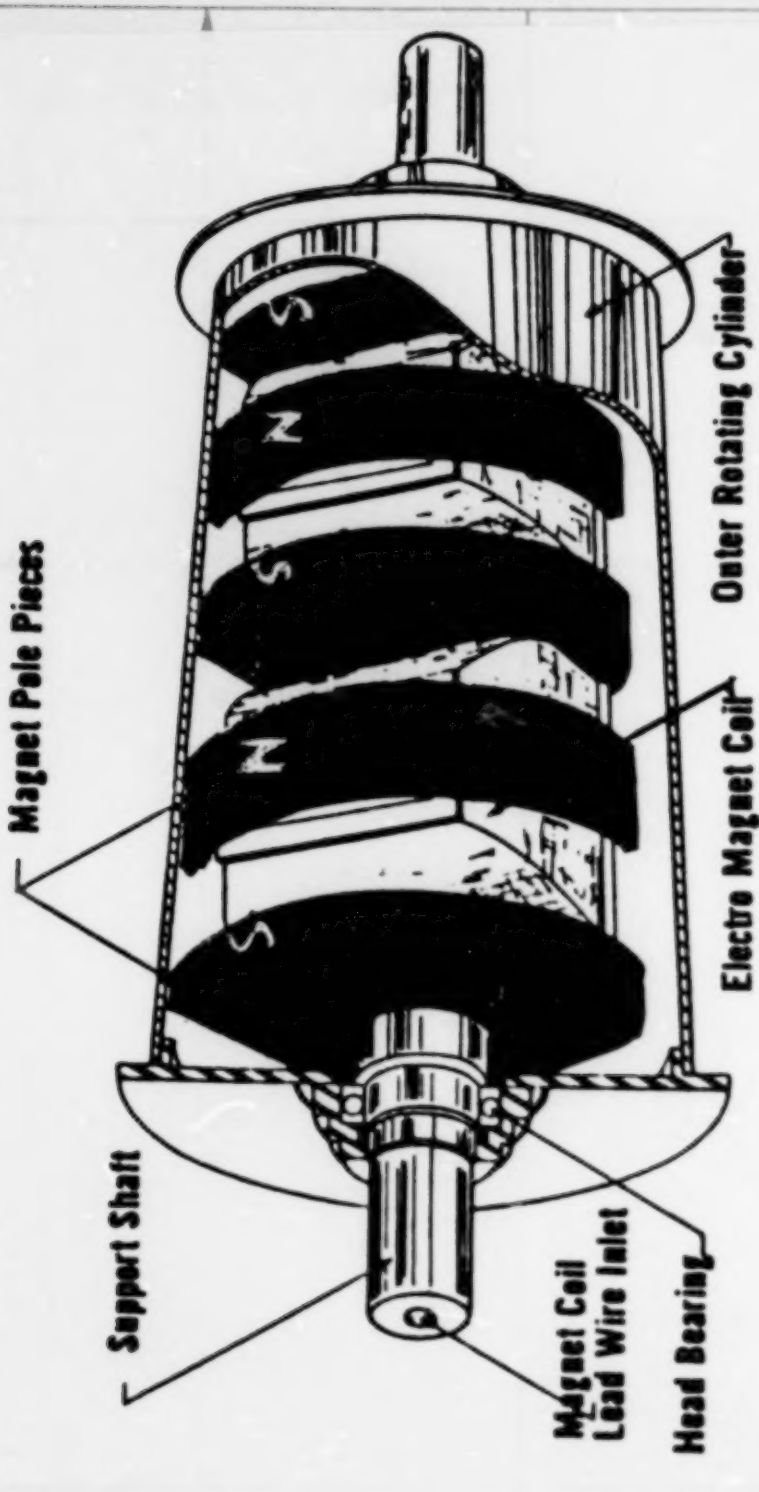

Figure 4. Sectional view of type "LD" magnetic drum.

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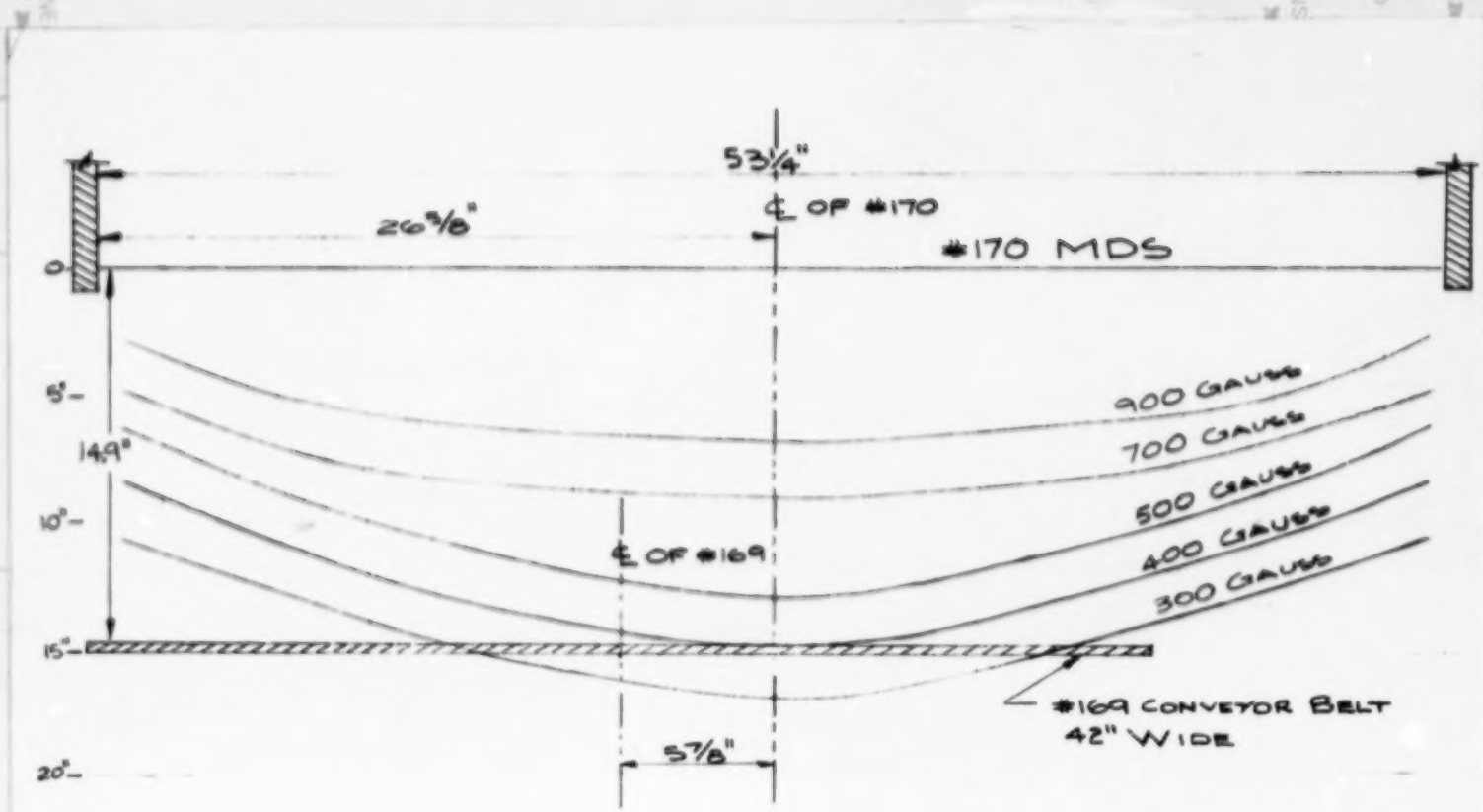

Figure 5. Gauss pattern of MDS (#170) at 14 amperes.
(Source: Stearns Magnetics)

TABLE 1. MDS (#170) AS-DESIGNED VS. AS-TESTED OPERATING PARAMETERS AND PERFORMANCE

	As-Designed	As-Tested
Feed rate	40 tph (max)	40.8 tph
Nominal particle size of feed	<5"	<4-3/4"
Bulk density of feed	10 lb/ft^3	16.5 lb/ft^3
Magnetics content of feed	7 to 10%	4.5%
Inclination (above horizontal)	17.9°	17.6°
Feed conveyor belt speed	300 to 350 fpm	360 fpm
Maximum burden depth	5.1" (est)	2.47"
Air gap (between belt and drum surfaces)	11.5"	14.9"
Angle (between a line joining shafts of #169 head pulley and MDS and the vertical)	27°	26.5°
Offset (between feed conveyor and MDS centerlines)	0"	5-7/8"
Maximum magnetic strength (at feed conveyor belt surface, est)	575 gauss @ 14 amps	440 gauss @ 15.3 amps
MDS rotational speed	28 rpm	28.3 rpm
% recovery of magnetics	95%	90.3%
Percent loose contaminants in product	3 to 5% (wet wt)	1.97% (wet wt)

(3) MSW was fed into the trommel for 4 to 5 minutes until the trommel underflow appeared to be at a steady mass flow rate.

(4) The trommel, trommel underflow discharge conveyor (#154), and MDS feed conveyor (#169) were then stopped simultaneously.

(5) The MDS product conveyor (#177) was stopped when all material had been conveyed beyond the MDS (#170).

(6) A tote bin was positioned by a forklift under a landfill-loadout discharge port for collection of the MDS tailings.

(7) The trommel-unders burden on MDS feed conveyor (#169) was measured for width and maximum depth at ten locations along its length (at approximately eight-foot intervals).

(8) The MDS feed conveyor (#169) was started, run for 15 seconds, then stopped.

(9) The MDS supply voltage and amperage were recorded.

(10) The MDS product accumulated on MDS product conveyor (#177) was collected in a 30-gallon capacity plastic bag; then sealed, labeled, and removed for analysis.

(11) The MDS tailings, collected in a tote bin, were secured with a plastic tarp, then removed for analysis.

(12) A two-foot length of trommel unders discharge conveyor (#154) (equivalent to one second of flow), at its discharge end was cleared and placed in a double-thickness (one bag inside another) 30-gallon capacity plastic bag, then sealed, labeled, and removed for moisture-content determination.

(13) All of Line No. 1 equipment was restarted, and the trommel fed for at least 2-1/2 minutes.

(14) Above steps (4) through (13) were repeated for the second replicate test run.

(15) Above steps (4) through (12) were repeated for the third replicate test run.

The MSW for this test was obtained from a 75-yd^3 compacted transfer trailer. Of the 37,550 lbs of refuse it contained, 23,010 lbs were unloaded and allocated for the test. When this

allocated MSW was placed to tipping floor level in Pit No. 1 at 12:15 PM, it covered 45 ft of Pit No. 1 conveyor (#150). The cross-sectional area of Pit No. 1 to tipping floor level is 30.76 ft^2. The bulk density of the MSW in the pit, calculated using these dimensional quantities, was 16.62 lb/ft^3.

From the beginning of the operating day, 7:00 AM, the MDS (#170) had been in normal service. The infeed of the test-allocated MSW into the trommel began at 12:30 PM, and the three replicate runs were executed as planned. The overall infeed mass flow rate into the trommel was 61.77 tph. The entire test took approximately 1-2/3 hours to execute.

SAMPLE PROCESSING

Drying of the trommel unders moisture samples was done in a laboratory oven (1 ft^3 capacity). It was necessary to divide the samples from Runs 1 and 2. The bags containing these two samples were manually tumbled for several minutes until thoroughly mixed. Each sample was then divided vertically; one-half was then placed in a metal container, weighed on a platform scale (capacity: 55 kg; readability: 0.01 kg), and placed in the oven. Oven temperature was set to 104°C. Drying continued until the rate of moisture loss was less than 0.1% of the original sample weight in any four-hour period. Table 2 gives the data for the three moisture samples.

TABLE 2. DATA FOR MOISTURE SAMPLES

	Run No. 1	Run No. 2	Run No. 3
Weight of sample collected	10.66 kg (23.50 lbs)	10.21 kg (22.51 lbs)	7.06 kg (15.56 lbs)
Weight of sample placed in oven	5.66 kg (12.48 lbs)	4.95 kg (10.91 lbs)	7.06 kg (15.56 lbs)
Time dried	73.5 hrs	95.5 hrs	98.0 hrs
Maximum temperature	114.0°C	114.5°C	112.0°C

MDS product material was weighed on the platform scale (described above) immediately after collection. Volume of the material was found by placing it in a nominally 2 ft^3 fiber drum [inside diameter 15.6" (0.395 m), inside height 18.9" (0.479 m)] and agitating the drum by rocking until the depth of material

remained constant. An average depth was computed, taking the mean of the depth at four equally spaced points along the circumference and one at the center. Bulk density was computed as follows:

$$B = \frac{W}{(\text{avg depth})(\text{drum radius})^2(\pi)}$$

where B = bulk density, lb/ft^3 (kg/m^3)
W = net weight of material, lb (kg)

MDS product was hand-sorted into categories. Magnetic material was further hand-sorted into subcategories described in Appendix A. Sorting was carried out as quickly as possible to minimize moisture loss. Less than two hours were required to complete the manual sorting for one run. Sorted material was placed into 4-gallon plastic bags.

Bags of sorted MDS product material were opened and allowed to air dry in a warm ventilated room for six days. Material was spread so that it was not more than one particle deep. After air drying, the sorted material was again placed into 4-gallon bags and weighed on the platform scale or triple-beam balance (capacity: 2,160 g; readability: 0.1 g), as appropriate. In later calculations, any moisture loss that had occurred during the hand-sorting was distributed to each component in proportion to its weight before air drying. Therefore, moisture loss was computed as follows:

$$A = \frac{[(\text{adjusted wt before air drying}) - (\text{wt after air drying})]}{\text{adjusted wt before air drying}} \times 100$$

where A = air-dry moisture loss, wet basis, %.

Sorted and air-dried MDS product material was screened on a Gilson Testing Screen [3], using 4", 2", 1", 1/2", and 1/4" screens, in the following manner:

The loose nonmagnetic material isolated in previous sorting was screened all together, i.e., paper, plastics, yard waste, etc., were loaded onto the screen at the same time. The criterion for the completion of screening was a weight change of 0.1% per minute (basis: weight of sample being screened) in the -1/4" fraction. Weight of the -1/4" fraction was measured on the triple-beam balance after 1, 5, and 10 minutes. It was found that a 10-minute interval was sufficient for screening this material. After screening, the nonmagnetic material in each size fraction was sorted again, and the components weighed.

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Each component of the magnetic material was screened separately on the Gilson Testing Screen. In the case of bimetal and tin-plated steel cans, it was sometimes necessary to screen in more than one batch to avoid loading the 2" screen more than one particle deep. Weight of the -1/4" fraction was measured on the triple-beam balance after 1, 5, and 10 minutes of screening. For all magnetic components, 10 minutes was sufficient time to meet the aforementioned criterion for completion of screening.

Magnetic material may be contaminated by food waste and other organic or inorganic nonmagnetics placed in a can at the time of disposal. In addition, contaminants may be pinched by magnetics during compaction into a packer truck or transfer trailer. The level of contamination was measured as follows:

After weighing a sorted sample of a particular size range, the removal of nonmagnetic material by manual means, such as scraping, prying, or wiping, was accomplished. The magnetic metal was then reweighed. Since it was impossible to manually remove some contaminants used in the manufacture of the item, including molded plastic seals on jar lids and bottlecaps, and paints and lacquers; the weight of these contaminants was included in the cleaned weight of magnetic material. In the case of grossly contaminated items which were virtually impossible to decontaminate by hand, the entire item was considered as a contaminant. Flashlight batteries and automotive parts were particularly troublesome in this regard. Sometimes two or three flashlight batteries appeared in a particular size fraction. When this occurred, one battery was weighed with the remaining cleaned magnetic material to represent the cleaned magnetic material in all batteries. Each of the three samples required approximately three hours to decontaminate.

The tailings were collected in 2 yd^3 or 3 yd^3 tote bins. The collected material was shoveled in batches into a nominally 2 ft^3 fiber drum (described above), which was lined with two 30-gallon plastic bags. Depth in the drum was measured after shaking, and the drum and contents weighed on the platform scale.

To determine the missed magnetics, each bag of tailings was hand-picked for magnetics, using a C-shaped Alnico magnet. Residual magnetic material found in this fashion was weighed. When grossly contaminated items (e.g., a board with two nails in it) were found, the entire item was considered a residual magnetic in this first step. These residual magnetics were subsequently analyzed in a similar manner as the magnetic material in the magnet product: bulk-density measuring, air drying, screening, sorting, and decontaminating were performed, in that order.

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SECTION 3

TEST RESULTS

This section expands on the data presented in Section 1, Introduction and Summary of Test Results. The first topic discussed concerns nomenclature: entrapped contamination and heavy ferrous. After that, the text turns to the question of magnet efficiency. Data are presented that detail overall magnet efficiency, efficiency by general classes of material (light- and heavy-gauge), by size classification and by type of material. In the latter case, a distinction is made, for example, among bimetal beverage cans and food cans. The methodology employed in this test is one of averaging the results of three test runs at nominal operating conditions. The final portion of this section discusses the appropriateness of using this approach. In effect, is each of the three runs representative? In terms of a number of factors, the individual test runs should be essentially alike. Unfortunately, not all of these factors are under the control of the test personnel, and some are only determined by post-test measurement.

NOMENCLATURE

The use of the term "entrapped contamination" brings to mind textiles and plastics caught on the jagged lip of a food can, as well as food material left in the can or placed in the can at the time of discard. And indeed, based on observation, this type of material appears to be the most significant contaminant. However, not all of the contamination is entrapped in this sense of the term. Some is physically joined and is part of the product. Therefore, included in all counts related to this category is some organic and some inorganic material; for example, the ceramic component of a spark plug is not ferrous metal, it is a contaminant, and it is included in the contamination figures. Inorganics of this type are more predominant in the non-can-related magnetics, i.e., the heavy ferrous, than they are in the can-related portion of either feed, product, or tailings, Although not measured, it is estimated by those who took part in the test that inorganics were about one-half (by weight, air dried) of the contamination of the heavy ferrous product. For the light ferrous, there was little inorganic contamination. Although it does not have the precision one might like, the "one-half" figure is used to

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apportion the air-dry moisture loss between the two main magnetic categories, i.e., light- and heavy-gauge. As we are only dealing with moisture, which is less than four percent of the total sample weight, the use of this estimator will not affect the results in a significant way.

Another word on nomenclature is in order. Although the term "heavy" is used throughout the text to describe one of the principal magnetic categories, the reader should not envision large pieces of iron. Rather, it is all of the magnetic material that is non-can related, such as the spark plugs mentioned earlier. Recall that, because the material that makes up the magnet's feedstock has passed through the 4-3/4" holes in the trommel, there simply were no large pieces.

MAGNET EFFICIENCY: THREE RUNS TAKEN TOGETHER

Table 3 (in three parts) presents the data used to compute magnet efficiency. The table presents data resulting from averaging the three test runs. The three parts of the table show in order: (A) the magnetic opportunities in the feed; (B) the magnet product; and (C) the missed magnetic opportunities in the tailings. Each portion of Table 3 shows composition in terms of the laboratory analysis (i.e., clean), as measured before the laboratory cleanup (dirty, air-dried), and finally, as-received (i.e., with the moisture loss that occurred during air drying apportioned between the two basic subcategories, light and heavy). The reason the term "estimate" is used to describe the as-received figures is that the estimating procedure described above was used. This was necessary because the actual measurement by subcategories was done air-dried rather than as-received. Appendix B contains the backup data for Table 3 and the other tables in this section.

In future tables, data on subcategories more detailed than light and heavy are presented either clean or air-dried, but not as-received. It is felt that the accuracy of the analysis would be lost if the moisture apportionment procedure were carried to smaller subcategories. The reader should note, however, that overall the weight of contamination for the light-gauge material is in fact about one-third higher as seen by the magnet than as reported here air-dried. In future tests, it would be preferable to immediately separate the material into the various subcategories and take weights as-received.

The efficiency of the magnet in terms of clean metal was 90% overall, 92.0% for the light-gauge magnetics, and 85% for the heavy ferrous. Table 4 gives these figures.

As mentioned earlier, the magnet acts as a differential separator. For the light-gauge magnetic material in the feed,

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TABLE 3. SAMPLE DATA

(Total Over Three Test Runs)

A. Composition of Feed (Ferrous Opportunities)

	Magnetic Material (Clean, lbs)	Magnetic Material (Dirty, lbs)	Contamination (lbs)	% Contamination
Light ferrous	33.41 (clean)	38.35 (dirty, air dried)	4.94 (air dried)	12.88 (air dried)
Heavy ferrous	12.38 (clean)	14.95 (dirty, air dried)	2.57 (air dried)	17.17 (air dried)
Total ferrous	45.79	53.30	7.51	14.08

Attached Contaminants (As-Received, lbs and Percent)

To light ferrous	6.86 lbs (as-received estimate)	17.04% (as-received estimate)
To heavy ferrous	2.85 lbs (as-recieved estimate)	18.71 (as-received estimate)
To total ferrous	9.71 lbs	17.49%

Sample size as-received: 55.50 lbs; loss of moisture during air drying: 2.20 lbs (3.97%). Weight of sample after air drying: 53.30 lbs. The data in this table were developed by summing the information in Tables 3-B and 3-C. All percentages are on a percent of whole basis. Loose contaminant in the feed was 964.19 lbs.

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TABLE 3 (continued)

B. Composition of Product (Acquired Ferrous Opportunities)

	Magnetic Material (Clean, lbs)	Magnetic Material (Dirty, lbs)	Contamination (lbs)	% Contamination
Light ferrous	30.83 (clean)	33.58 (dirty, air dried)	2.75 (air dried)	8.17 (air dried)
Heavy ferrous	10.52 (clean)	11.02 (dirty, air dried)	0.50 (air dried)	4.57 (air dried)
Total ferrous	41.35	44.60	3.25	7.28

Attached Contaminants (As-Received, lbs and Percent)

To light ferrous	4.38 lbs (as-received estimate)	12.43% (as-received estimate)
To heavy ferrous	0.64 lb (as-received estimate)	5.85 (as-received estimate)
To total ferrous	5.03 lbs	10.85%

Sample size as received: 46.39 lbs; loss of moisture during air drying: 1.78 lbs (3.84%). Weight of sample after air drying: 44.60 lbs. One-half of contaminants in heavy ferrous fraction assumed to be non-moisture-retaining and therefore not used in the allocation of the air-dried moisture loss to produce the as-received contamination estimates. All percentages are on a percent of whole basis. Loose contaminant in the product was 0.94 lbs.

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TABLE 3 (continued)

C. Composition of Tailings (Missed Ferrous Opportunities

	Magnetic Material (Clean, lbs)	Magnetic Material (Dirty, lbs)	Contamination (lbs)	% Contamination
Light ferrous	2.57 (clean)	4.77 (dirty, air dried)	2.20 (air dried)	46.04 (air dried)
Heavy ferrous	1.86 (clean)	3.92 (dirty, air dried)	2.06 (air dried)	52.56 (air dried)
Total ferrous	4.43	8.69	4.26	48.98

Attached Contaminants (As-Received, lbs and Percent)

To light ferrous	2.48 lbs (as-received estimate)	49.08% (as-received estimate)
To heavy ferrous	2.20 lbs (as-received estimate)	54.13 (as-received estimate)
To total ferrous	4.68 lbs	51.38%

Sample size as-received: 9.11 lbs; loss of moisture during air drying: 0.42 lb (4.60%). Weight of sample after air drying: 8.69 lbs. One-half of contaminants in heavy ferrous fraction assumed to be non-moisture-retaining and therefore not used in the allocation of the air-dried moisture loss to produce the as-received contamination estimates. All percentages are on a percent of whole basis. Loose contaminant in the tailings was 963.26 lbs.

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TABLE 4. MAGNET EFFICIENCY

Light magnetics (clean)	92.3%	Light magnetics (as-received)	87.5%
Heavy magnetics (clean)	85.0	Heavy magnetics (as-received)	73.5
Total magnetics (clean)	90.3%	Total magnetics (as-received)	83.6%

the percent contamination as-received was estimated to be approximately 17%. This was reduced to 12-1/2% in the light ferrous product, while the contamination in the light ferrous that was missed was 49%. Overall (i.e., combining the light with the heavy metal), the contamination of the ferrous product on the as-received basis is estimated to be approximately 12%. If all the magnetics had been recovered, it is estimated that the contamination of the light/heavy product mix would have been about 21%.

Table 5 converts the sample magnet product weights into lbs/hr and tons/day and shows that the magnet should produce 3,310 lbs of clean metal per hour, or 17.2 short tons per 650-ton MSW day. This is the contract MSW tonnage. The magnetic metals extracted, including the contaminants (both entrapped and loose), would be 19.7 tons. As mentioned in the Introduction, the ferrous metal recovery system has an additional step which is designed to separate the light-gauge from the heavy magnetics and to remove loose organics. If perfect separation of heavy ferrous and loose organics were accomplished by the cleanup steps, the shipped material would average 2,820 lbs/hr (14.7 tons/day) on an as-received basis. Of this, 350 lbs/hr would be entrapped contamination, i.e., 12.4% of the shipped material would be contamination. This is well above the target figure of 4% nonmagnetic material offered as a market specification by Proler International, the customer for the light ferrous.*

As described in the Introduction, the bulk of the ferrous product is in the -4" +2" size range. The principal reason for this is that there is more opportunity in this size range. On an air-dried basis, Table 6 shows that 72% of the magnetic material

*Note that the specification is for nonmagnetics, which would include the aluminum ends of bimetal cans, inasmuch as they are shredded off by Proler's processing. These ends are included here in magnetic opportunity, product, and tailings. They are not considered as contaminants.

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TABLE 5. FERROUS OPPORTUNITY AND PRODUCT
(Clean and As-Received Basis)

Metal	Sum of Three Samples (lbs)	Lbs/Hr	Tons/Day
Ferrous Opportunity			
Light (clean)	33.41	2,670	13.9
Heavy (clean)	12.38	990	5.2
Total	45.79	3,660	19.1
Light (as-received)	40.27	3,220	16.8
Heavy (as-received)	15.23	1,220	6.3
Total	55.50	4,440	23.1
Ferrous Product			
Light (clean)	30.83	2,470	12.8
Heavy (clean)	10.52	840	4.4
Total	41.35	3,310	17.2
Light (as-received)	35.22	2,820	14.7
Heavy (as-received)	11.17	890	4.6
Total	46.39	3,710	19.3

Tons per day is based on 650 tons of waste processed to the trommel at 62.5 tph. Tons are short tons (2,000 lbs). The product also would have 75 lbs/hr of loose contamination, or 0.4 tons/day.

TABLE 6. COMPOSITION: SIZE DISTRIBUTION AND FERROUS TYPE, COMPOSITE OF THREE RUNS

(All Figures in Percent: Rounded)

	Feed	Product	Tailings	Magnet Efficiency
		Air Dried		
Size Distribution				
+4"	1	1	4	47
-4" +2"	72	77	48	89
-2" +1"	13	11	24	70
-1" +1/2"	10	9	16	74
Type				
Bimetal cans	15	17	4	96
Food cans	40	45	9	96
Composite cans	3	tr	14	11
Other cans	4	4	1	97
Caps, tops, lids	11	8	28	60
Total can-related	72	75	55	88
Non-can	28	25	45	74
Total	100	100	100	Avg. 84
		Clean		
Size Distribution				
+4"	1	1	3	70
-4" +2"	72	76	30	96
-2" +1"	12	10	24	80
-1" +1/2"	11	9	29	75
Type				
Bimetal cans	17	18	7	96
Food cans	40	44	7	98
Composite cans	1	tr	7	15
Other cans	4	4	1	97
Caps, tops, lids	11	8	35	69
Total can-related	73	75	58	92
Non-can	27	25	42	85
Total	100	100	100	Avg. 90

by weight in the feed is in this size range. It is the same on a clean-metal basis.

Magnet efficiency is also a function of the type of ferrous opportunity. As mentioned earlier, data were taken that categorized ferrous as a bimetal beverage can, a food can, a composite can, etc. Also, the amount of non-can material - called at times in this report heavy ferrous - was determined. Magnet efficiency was highest for the food cans (98% clean-metal basis and 96% on an air-dried basis). Efficiency was lowest for the composite can, at 11%. This is fortunate, since, as pointed out in the Introduction, the contamination level of the composite cans average 71% (see Table 7).

TABLE 7. CONTAMINATION IN PERCENT

Composite of Three Runs, Air-Dried Basis

	Feed	Product	Tailings
Size Distribution			
+4"	34	1	63
-4" +2"	14	8	68
-2" +1"	21	8	49
-1" +1/2"	5	4	10
Type			
Bimetal cans	2	2	0
Food cans	12	10	59
Composite cans	71	61	72
Other cans	6	7	0
Caps, Tops, Lids	19	8	36
Total can related	13	8	46
Non-can	17	5	53
Total	14	7	49

COMPARISON OF DATA AMONG RUNS

For this test series, the principal reason for describing similarities and differences among the three runs is to determine if they are enough alike that none would be considered an "outlier." The methodology for this test, which takes into account budget limitations, is one of averaging to estimate

performance under nominal operating conditions. With only three runs to average, one would like to have as many fixed parameters among runs as possible. That way, one has greater confidence that the measured magnet efficiency has been legitimately determined. This is important, since there was a measured difference in magnet efficiency among runs. Table 8 presents the data on overall magnet efficiency on a clean-metal and as-received basis. The range is plus or minus approximately 3% from the mean. This is a fairly tight grouping and offers support for the averaging approach.

TABLE 8. MAGNET EFFICIENCY BY RUN

(All Figures in Percent)

	Run 1	Run 2	Run 3	Composite
Clean-metal basis	87.8	90.0	93.3	90.3
As-received basis	82.0	83.4	85.4	83.6

Table 9 shows magnet efficiency for each of the runs by size range and type of magnetic. Note that there is some variability among runs and that this is more prevalent in some categories than in others. From the limited number of runs associated with this test, it is not possible to determine what caused the variability in magnet efficiency that did occur. As mentioned in the Introduction, more runs, larger samples, and some different and more sophisticated measurements, such as location of the ferrous in the burden, would be necessary to estimate and verify any model postulated as to the determinants of magnet efficiency. What follows here is conjecture offered to illustrate in terms of the data developed some of the likely relationships among the measurements taken and magnet efficiency.

Turning to the input side then, Table 10 gives a number of factors which should be essentially the same among runs. In formal terms, these are called the independent variables. The dependent variable is, of course, magnet efficiency.

As mentioned earlier, the gauss strength was higher for Run 1, as was the flow rate. Run 3, which was the most productive run, had the highest level of ferrous opportunity, as seen under "Percent of Feed" in the table. While the three runs were essentially similar in the composition of their feed, Run 2 was somewhat higher in bimetal cans and in overall can-related ferrous than the other two. Run 1, the lowest efficiency run, was also the run with the lowest relative weight in beverage

TABLE 9. MAGNET EFFICIENCY

Air Dried Basis

(All Figures in Percent)

	Run 1	Run 2	Run 3	Composite
Size Distribution				
+4"	0	100	0	47
-4" +2"	89	89	89	89
-2" +1"	69	56	76	70
-1" +1/2"	72	74	76	74
Type				
Bimetal cans	91	96	100	96
Food cans	92	100	99	96
Composite cans	0	2	52	11
Other cans	100	92	100	97
Caps, tops, lids	61	69	53	60
Total can related	85	87	91	88
Non-can	72	71	76	74
Overall	82	84	85	84

TABLE 10. COMPARISON OF DATA AMONG RUNS

	Run 1	Run 2	Run 3	Composite
Factor				
Magnetic field strength (gauss)	455	430	430	438
Flow rate (tph)	46.36	36.19	39.81	40.79
Moisture (% as-received)	22.7	28.1	24.0	24.7
Maximum burden depth (in.)	2.45	2.50	2.45	2.47
Density (lb/ft^3)	18.72	15.17	15.45	16.45
Feed rate (lb/sec) passing magnet	25.76	20.11	22.12	22.66
Ferrous Opportunity (lbs)				
As-received	20.68	14.70	20.11	18.50
Clean	17.62	12.27	15.83	15.26
Percent of Feed				
As-received	5.4	4.9	6.1	5.4
Clean	4.6	4.1	4.8	4.5

cans, 12% vs 16% for Run 3, and 18% for Run 1. This may have contributed to the decreased Run 1 overall efficiency.

Type of ferrous opportunity, as described in this paragraph, correlates with percent contamination. Referring to an earlier table (Table 7), on average the bimetal beverage cans in the feed had only 2% entrapped contamination, while the food cans had 12%. The composite cans, primarily of organic material, were found to contain only 29% ferrous, i.e., there was 71% organic contamination. Fortunately, the magnet, acting as a differential separator, only extracted 11% of these cans, letting the remainder go to the tailings. Those extracted averaged 61% contamination.

Referring to Table 11, in each run the percentage of cans versus non-can material in the product was higher than in the feedstock, with bimetal cans rising by two percentage points. Food cans rose by five percentage points. The relative increase in food and beverage cans was at the expense of composite cans, tops, and lids, and non-can related ferrous, with the latter falling by three or four percentage points in each run.

TABLE 11. FERROUS DISTRIBUTION IN PERCENT

Air Dried Basis: Rounded

	Run 1	Run 2	Run 3	Composite
Ferrous Opportunities in Feed				
Size Distribution				
+4"	2	2	0	1
-4" +2"	68	75	74	72
-2" +1"	14	9	14	13
-1" +1/2"	13	9	8	10
Type				
Bimetal cans	12	18	16	15
Food cans	43	41	35	40
Composite cans	1	6	1	3
Other cans	4	5	2	4
Caps, tops, lids	13	10	11	11
Total can-related	73	80	65	72
Non-can	27	20	35	28
Total	100	100	100	100

(continued)

TABLE 11 (continued

	Run 1	Run 2	Run 3	Composite
Ferrous Product				
Size Distribution				
+4"	1	3	0	1
-4" +2"	74	80	77	77
-2" +1"	12	6	12	11
-1" +1/2"	11	8	8	9
Type				
Bimetal cans	14	20	19	17
Food cans	48	49	41	45
Composite cans	0	tr	1	0
Other cans	5	6	2	4
Caps, tops, lids	10	8	7	8
Total can-related	77	83	69	75
Non-can	23	17	31	25
Total	100	100	100	100
Magnetics in Tailings				
Size Distribution				
+4"	10	0	0	4
-4" +2"	40	50	57	48
-2" +1"	24	25	22	24
-1" +1/2"	19	15	14	16
Type				
Bimetal cans	6	5	0	4
Food cans	19	0	3	9
Composite cans	6	37	4	14
Other cans	0	3	0	1
Caps, tops, lids	28	19	34	28
Total can-related	60	64	42	55
Non-can	40	36	58	45
Total	100	100	100	100

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Returning to Table 9 to look at the similarities and differences in magnet efficiency by size range and type of metal classification, there was a consistency in the two main classifications, i.e., -4" +2" and -1" +1/2". There was a difference in the -2" +1" category in that the magnet during Run 2 was quite a bit less efficient in this size range. However, as shown in Table 11, only 9% of the total metal opportunity was in this size range (air-dried basis). And, as shown by the data in Appendix B, the level of contamination in this size range was substantially higher for Run 2 than the other two runs.

The lower part of Table 9 shows data by metal type. Only in the composite can category is there a major difference in magnet efficiency among runs. In Run 3, there were four composite cans with an average contamination of 63%. (This data comes from Table B-14 in Appendix B.) Two were recovered. The average contamination of the recovered cans was 66%. This contamination, of course, was the cardboard bodies. On a dry-weight basis, these two cans were 0.8% of the total product. In terms of clean metal, they comprised less than one-tenth of a pound out of nearly 16 pounds of ferrous metal in the sample. This illustrates that a data point that at first glance appears to represent a significant difference among the runs can turn out on further examination to be of little moment.

ENGLISH TO METRIC CONVERSION

To Convert	Multiply By	To Obtain
pounds	453.6	grams
ton (short)	.9078	ton (metric)
inches	2.54	centimeters
feet	.3048	meters
cubic feet	.0283	cubic meters

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REFERENCES

1. H. Alter, S. L. Natof, K. L. Woodruff, and R. D. Hagen, The Recovery of Magnetic Metals from Municipal Solid Waste, RM 77-1, National Center for Resource Recovery, Inc., Washington, D. C., 1977, 59 pp.

2. National Center for Resource Recovery, Inc., New Orleans Resource Recovery Facility Implementation Study - Equipment, Economics, Environment, National Center for Resource Recovery, Inc., Washington, D. C., 1977, 427 pp.

3. American Society for Testing and Materials, Manual on Test Sieving Methods, ASTM Special Technical Publication 447A, ASTM, Philadelphia, Pennsylvania, 1972, 43 pp.

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APPENDIX A

MAGNETICS SORTING CATEGORIES

CAN-RELATED MAGNETICS

Bimetallic Cans

These are containers constructed of principally two metals: magnetic steel for the body and bottom, and aluminum for the top. They commonly appear in MSW as post-consumer beverage containers: beer, soda, juice, etc. Two types of construction predominate:

(1) Three-piece construction, with a steel body and bottom and an aluminum top. These commonly appear in 12-, 8-, and 6-fluid ounce capacities.

(2) Two-piece construction with a single-piece, wrought-steel body and bottom and an aluminum top. These commonly appear in 12 fluid ounce capacity. Both types usually have lacquer/pigment labels. The aluminum top of a two-piece can represents a larger proportion of the total weight than for the three-piece can.

Tin-Plated Steel Food Cans

This category includes a large variety of containers which have different shapes, capacities, wall thicknesses, etc., but have in common that they are tin-plated magnetic steel containers that were used for packaging foods. They are of three- or two-piece construction and commonly appear with a paper label affixed to the can by adhesive or with a lacquer/pigment label. Common examples are cans used to package soups, vegetables, tuna fish, evaporated milk, chili, etc. Also included in this category are the ends of cans cut out by the consumer.

Composite Cans

These are cans constructed with one or two magnetic steel ends and a mainly non-metallic body. The bodies are commonly constructed mainly of paperboard or plastic. Common examples are frozen juice, biscuit, and motor oil containers. Some motor oil containers are of two-piece construction with a one-piece plastic body and bottom and a steel top; other motor oil and other

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containers are of three-piece construction originally manufactured with a non-metallic body and two steel ends.

Other Cans

This category encompasses the remainder of post-consumer containers constructed of magnetic steel. Common examples are aerosol cans, paint and solvent cans, lighter fuel cans, motor oil, brake fluid, and other automotive fluid cans. Some are tin-plated and have lacquer/pigment or paper labels.

Caps, Tops, Lids

This category includes magnetic steel bottle caps, tops removed from composite cans, jar lids, etc., which had once sealed a container and were usually removed by the consumer by prying, unscrewing, etc. They are often painted or lacquered and may contain waxed paperboard or plastic gasket liners.

NON-CAN MAGNETICS

All Magnetic Non-Can

This category of magnetics includes miscellaneous items originally manufactured of magnetic metal, e.g., hardware, hangers, wire, strapping, tools, etc. The category contains magnetic items which were galvanized, chrome-plated, painted, lacquered, or otherwise coated in their original manufacture. These items are considered to be all magnetic. In addition, the category contains those all-magnetic items with foreign materials (contaminants) attached as the result of commingling in the refuse.

Composite Non-Can Magnetics

This category includes miscellaneous non-can-related items constructed in part of magnetic metal. Examples are: a leather belt with a magnetic buckle, various auto parts (steel spark plugs with ceramic collars, steel oil filters with paper elements, etc.), plastic or wooden clothespins with steel springs, lumber with steel nails embedded, a steel kitchen utensil with a pastic handle, etc.

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APPENDIX B

TABLE B-1. TEST NO. 4.01 DATA SHEET

1) FEED STOCK
   a) SOURCE: FLORIDA AVE. TRANSFER STATION
   b) TRANSFER TRAILER NUMBER & CAPACITY: TT30; 75 yd^3
   c) DATE @ TIME RECEIVED: WED. 10/4/78 @ 9:09 A.M.
   d) WEIGHT OF REFUSE UNLOADED: 23,010 lb

2) LENGTH OF PIT NO.1 CONVEYOR (#150) FILLED: 45 ft

3) SPECIFIED TROMMEL INFEED RATE: 62.5 tph

4) PIT NO.1 CONVEYOR (#150) SPEED REQUIRED: 4.07 fpm

5) PIT NO.1 CONVEYOR SPEED SET: 4.10 fpm

6) TROMMEL UNDERS DISCHARGE CONVEYOR (#154) SPEED: 118 fpm

7) TROMMEL UNDERS MDS FEED CONVEYOR (#169) SPEED: 360 fpm

8) MDS (#170) ROTATIONAL SPEED: 28.3 rpm

9) AIR GAP BETWEEN MDS (#170) & FEED CONVEYOR (#169) BELT SURFACES: 14.9 in.

	RUN NO. 1	2	3	COMPOSITE OR AVERAGE
10) MDS (#170) COIL SUPPLY VOLTAGE:	247	247	247	247 Volts DC
AMPERAGE:	15.8	15.0	15.0	15.3 amps
11) MDS (#170) MAGNETIC FIELD STRENGTH AT CONVEYOR (#169) BELT SURFACE MAXIMUM (EST.):	455	430	430	438 gauss
12) FEED TIME TO TROMMEL:	309.3	210.8	150.4	670.5 sec.
13) AVERAGE TROMMEL INFEED MASS FLOW RATE:				61.77 tph

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TABLE B-1 (continued)

	RUN NO. 1	2	3	COMPOSITE OR AVERAGE
14.) MDS FEED CONVEYOR (#169) BURDEN				
AVERAGE MAX. DEPTH:	2.45	2.50	2.45	2.47 in.
AVERAGE WIDTH:	19.8	19.4	20.15	19.78 in.
15.) FEED TIME TO MDS (#170):	15.0	15.0	15.0	45.0 sec
16.) MDS PRODUCT COLLECTED				
a.) TOTAL WEIGHT:	17.22	12.45	17.66	47.32 lb
b.) MASS FLOW RATE:	2.07	1.49	2.12	1.89 tph
c.) BULK DENSITY:	11.92	12.77	13.30	12.63 lb/ft^3
d.) MAGNETICS CONTENT (AS REC'D):	16.9497	12.2612	17.1753	46.3862 lb
e.) MAGNETICS CONTENT (CLEAN):	15.5355	11.0461	14.7732	41.3548 lb
17.) SCALPED TROMMEL UNDERS COLLECTED				
a.) TOTAL WEIGHT:	369.15	289.13	314.09	972.37 lb
b.) MASS FLOW RATE:	44.30	34.70	37.69	38.89 tph
c.) BULK DENSITY:	27.52	22.21	24.62	24.80 lb/ft^3
d.) MAGNETICS CONTENT (AS REC'D):	3.7317	2.4433	2.9363	9.1113 lb
e.) MAGNETICS CONTENT (CLEAN):	2.1508	1.2288	1.0547	4.4343 lb
18.) TROMMEL UNDERS FEED TO MDS (#170)				
a.) TOTAL WEIGHT:	386.36	301.58	331.75	1019.69 lb
b.) MASS FLOW RATE:	46.36	36.19	39.81	40.79 tph
c.) BULK DENSITY ON FEED CONVEYOR:	18.72	15.17	15.45	16.45 lb/ft^3
d.) TOTAL MOISTURE (WET-WT. BASIS):	22.7	28.1	24.0	24.7 %
e.) MAGNETICS CONTENT (AS REC'D):	20.6814	14.7046	20.1116	55.49761b
f.) MAGNETICS CONTENT (CLEAN):	17.6863	12.2749	15.8279	45.7891 lb

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TABLE B-2. COMPOSITION/PARTICLE-SIZE DISTRIBUTION OF MAGNETICS IN FEED

TEST No.: 4.01
DATE: 4 Oct. '78
RUN No.: 1
SAMPLE: MAGNETICS IN MDS FEED (COMPOSITE)

SAMPLE WT., WET: 9.3811 Kg (20.6814 lb)
AIR DRY LOSS, WET-WT. BASIS: 3.42 %
SAMPLE WT. SCREENED, AIR-DRY: 9.0609 Kg (19.9744 lb)

| COMPONENT | SIEVE-SIZE RANGE | | |

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TABLE B-3. COMPOSITION/PARTICLE-SIZE DISTRIBUTION OF MAGNET PRODUCT

TEST No.: 4.01
DATE: 4 Oct. '78
RUN No.: 1
SAMPLE: MDS Product

SAMPLE WT. (WET): 7.81 kg (17.22 lb)
BULK DENSITY (WET WT.): 11.92 lb/ft³
TIME COMPONENTS AIR DRIED: 6 days
TIME COMPONENTS SCREENED: 10 min.
TOTAL WT. SCREENED (AIR DRY): 7.5184 kg (16.5750 lb)

COMPONENT (AIR DRY LOSS, WET WT. BASIS)	SIEVE-SIZE RANGE						
	+4 in.	-4+2	-2+1	-1+0.5	-0.5+0.25	-0.25	TOTAL
PAPER PRODUCTS (20.96%)	7.08 / 57.29	42.73 / 0.60	48.95 / 3.77	3.73 / 0.35	0.51 / 0.32	— / —	100 / 1.03
YARD WASTE (22.22%)	/	/	14.29 / 0.02	50.00 / 0.08	35.71 / 0.40	— / —	100 / 0.02
PLASTICS (13.73%)	93.18 / 42.71	/	/	6.82 / 0.04	/	— / —	100 / 0.06
OTHER HEAVY ORGANICS (2.30%)	/	/	94.87 / 0.78	/	5.13 / 0.32	— / —	100 / 0.10
FERROUS (3.48%)	/	74.22 / 99.40	12.18 / 95.43	11.20 / 99.53	1.65 / 97.85	0.75 / 92.26	100 / 98.70
ALUMINUM —	/	/	/	/	/	— / —	0 / 0
OTHER NON-FERROUS —	/	/	/	/	/	— / —	0 / 0
GLASS 0	/	/	/	/	100 / 1.12	— / —	100 / 0.02
STONES & CERAMICS —	/	/	/	/	/	— / —	0 / 0
-.25 in FINES (32.86%)	— / —	— / —	— / —	— / —	— / —	100 / 7.74	100 / 0.06
TOTAL. (3.73%)	0.13 / 100	73.70 / 100	12.60 / 100	11.10 / 100	1.67 / 100	0.81 / 100	100 / 100

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TABLE B-4. COMPOSITION/PARTICLE-SIZE DISTRIBUTION OF MAGNETICS IN PRODUCT

TEST No: 4.01
DATE: 4 OCT. '78
RUN No: 1
SAMPLE: MDS PRODUCT MAGNETICS (FERROUS)

SAMPLE WT., WET: 7.6884 Kg (16.949 lb)
TOTAL WT. SCREENED, AIR DRY: 7.4210 Kg (16.3406 lb)

COMPONENT (AIR DRY LOSS, WET WT. BASIS)	SIEVE-SIZE RANGE													
	+4 in.		-4+2		-2+1		-1+0.5		-0.5+0.25		-0.25		TOTAL	
BIMETALLIC CANS (1.72 %)			22	1.27									22	1.27
			100										100	
			18.38										13.64	
TIN-PLATED STEEL FOOD CANS (5.13%)			68	8.34	24	6.45							92	8.22
			93.91		6.09								100	
			60.78		24.02								48.04	
COMPOSITE CANS —													0	—
													0	
													0	
OTHER CANS (0.82 %)			4	0.19									4	0.19
			100										100	
			6.78										5.03	
CAPS, TOPS, LIDS (3.65 %)			13	9.39	31	10.70	110	1.52					154	7.16
			30.53		35.27		34.20						100	
			4.04		28.45		30.00						9.82	
TOTAL CAN-RELATED MAGNETICS (4.07%)			107	6.33	55	8.76	110	1.52					272	6.32
			87.26		8.35		4.39						100	
			89.98		52.47		30.00						76.58	
TOTAL NON-CAN MAGNETICS (1.49%)			1	0.31	17	0.30	42	1.89	37	0.57	38	0.89	135	0.87
			31.68		24.66		38.39		7.04		3.21		100	
			10.02		47.53		70.00		100		100		23.47	
TOTAL (3.48%)			108	5.72	72	4.74	152	1.78	37	0.57	38	0.89	407	5.04
			74.22		12.18		11.20		1.65		0.75		100	
			100		100		100		100		100		100	

No. OF PARTICLES ⇦ ⇨ % ATTACHED CONTAMINATION OF MAGNETICS
COMPOSITION OF SIZE RANGE ⇩ ⇨ % OF COMPONENT IN SIZE RANGE (WT. %, air-dry basis)

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TABLE B-5. MDS RECOVERY: CLEAN-METAL BASIS

TEST NO.: 4.01
DATE: 4 OCT. '78
RUN NO.: 1

COMPONENT	SIEVE-SIZE RANGE															
	+4 in.		-4+2		-2+1		-1+0.5		-0.5+0.25		-0.25		TOTAL	
BIMETALLIC CANS			91.67	100									91.67	100
			91.25										91.25	
TIN-PLATED STEEL FOOD CANS			95.77	96.84	96.80	100							96.83	98.18
			96.84		98.35								96.93	
COMPOSITE CANS			0	0									0	0
			0										0	
OTHER CANS			100	100									100	100
			100										100	
CAPS, TOPS, LIDS			81.25	80.96	60.78	77.12	56.70	52.78	0	0			58.78	87.09
			81.43		67.65		56.71		0				65.91	
TOTAL CAN-RELATED MAGNETICS			89.92	91.69	77.37	90.01	56.70	52.78	0	0			69.74	87.71
			94.60		79.12		56.71		0				90.13	
TOTAL NON-CAN MAGNETICS	0	0	0.90	0.49	58.62	1.41	57.53	17.77	36.92	24.14	38.00	100	83.83	5.32
	0		88.93		81.18		86.47		75.78		51.82		81.46	
TOTAL	0	0	89.24	89.82	59.97	78.68	56.93	51.42	36.58	24.14	38.00	100	58.34	86.04
	0		93.79		80.13		75.71		73.14		51.82		87.84	

% OF PARTICLES RECOVERED

% OF ATTACHED CONTAMINATION RECOVERED (air-dry WT. BASIS)

% OF MAGNETIC METAL RECOVERED (clean-magnetic-metal WT. BASIS)

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TABLE B-6. MDS RECOVERY: AIR-DRIED BASIS

TEST No.: 4.01
DATE: 4 OCT 78
RUN No.: 1

COMPONENT	SIEVE-SIZE RANGE						
	+4 in.	-4+2	-2+1	-1+0.5	-0.5+0.25	-0.25	TOTAL
BIMETALLIC CANS							
		91.35					91.35
TIN-PLATED STEEL FOOD CANS							
		91.49	97.46				91.89
COMPOSITE CANS							
		0					0
OTHER CANS							
		100					100
CAPS, TOPS, LIDS							
		79.76	55.33	56.65	0		61.28
TOTAL CAN-RELATED MAGNETICS							
		89.71		56.65	0		85.34
TOTAL NON-CAN MAGNETICS							
	0	35.53	69.32	83.28	74.86	52.09	72.48
TOTAL							
	0	89.28	69.26	72.44	72.30	52.04	81.91

% OF PARTICLES RECOVERED
% OF ATTACHED CONTAMINATION RECOVERED (air-dry wt. basis)
% OF MAGNETIC METAL RECOVERED (AIR-DRY WT. BASIS)

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TABLE B-7. COMPOSITION/PARTICLE-SIZE DISTRIBUTION OF MAGNETICS IN TAILINGS

TEST No: 4.01
DATE: 4 OCT. '78
RUN No: 1
SAMPLE: Residual Magnetics (in MDS Tailings)

SAMPLE WT., WET: 1.6927 Kg (3.7317 lb)
BULK DENSITY, WET WT: 19.79 lb/ft³
TIME AIR DRIED: 3 days
AIR DRY LOSS, WET-WT. BASIS: 3.16 %
TIME SCREENED: 10 min.
SAMPLE WT. SCREENED, AIR DRY: 1.6394 Kg (3.6142 lb)

COMPONENT	SIEVE-SIZE RANGE						
	+4 in.	-4+2	-2+1	-1+0.5	-0.5+0.25	-0.25	TOTAL
BIMETALLIC CANS		2 0 100 14.49					2 0 100 5.84
TIN-PLATED STEEL FOOD CANS		3 67.00 98.92 47.06	1 0 1.08 0.86				4 67.10 100 19.19
COMPOSITE CANS		4 [illegible] 100 15.85					4 [illegible] 100 6.89
OTHER CANS							0 - 0 0
CAPS, TOPS LIDS		3 [illegible] 12.26 8.54	20 [illegible] 45.06 51.76	84 1.78 41.42 60.36	1 0 1.26 12.34		108 [illegible] 100 28.10
TOTAL CAN-RELATED MAGNETICS		12 [illegible] 58.23 85.94	21 [illegible] 21.62 32.61	86 1.78 19.85 60.86	1 0 0.59 12.34		118 [illegible] 100 59.53
ALL MAGNETIC NON-CAN			6 0 24.74 12.81	24 0 33.11 21.77	35 0 17.61 77.87	60 0 24.64 90.84	125 0 100 12.68
COMPOSITE NON-CAN MAGNETICS	1 62.91 35.62 100	1 [illegible] 20.41 14.06	6 [illegible] 30.44 34.38	7 [illegible] 12.40 17.87	11 [illegible] 1.01 9.79	2 0 0.13 1.16	28 [illegible] 100 27.80
TOTAL NON-CAN MAGNETICS	1 62.91 24.46 100	1 [illegible] 14.02 14.06	12 [illegible] 28.69 47.89	31 [illegible] 18.88 39.64	66 [illegible] 6.21 87.66	62 0 7.78 100	173 [illegible] 100 40.47
TOTAL	1 62.91 9.90 100	13 [illegible] 40.34 100	33 [illegible] 24.47 100	115 [illegible] 19.88 100	67 [illegible] 2.87 100	62 0 3.16 100	291 [illegible] 100 100

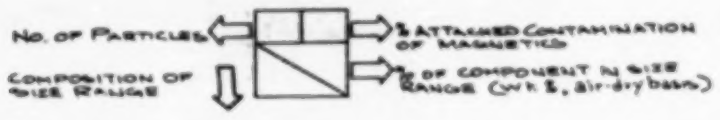
No. of Particles
% Attached Contamination of Magnetics
Composition of Size Range
% of Component in Size Range (wt %, air-dry basis)

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TABLE B-8. COMPOSITION/PARTICLE-SIZE DISTRIBUTION OF MAGNETICS IN FEED

TEST No: 4.01
DATE: 4 OCT. '78
RUN No: 2
SAMPLE: MAGNETICS IN HDS FEED (COMPOSITE)

SAMPLE WT., WET: 6.670 g (14.704 lb)
AIR DRY LOSS, WET-WT. BASIS: 45.2%
SAMPLE WT. SCREENED, AIR-DRY BASIS: 6.3666 g (14.0399 lb)

COMPONENT	SIEVE-SIZE RANGE													
	+4 in.		-4+2		-2+1		-1+0.5		-0.5+0.25		-0.25		TOTAL	
BIMETALLIC CANS			24	1.91									24	1.91
			100										100	
			23.29										17.62	
TIN-PLATED STEEL FOOD CANS	1	0.55	57	7.41	17	4.93	1	2.50					76	2.02
	5.53		89.23		4.73		0.41						100	
	100		48.62		21.05		1.85						40.04	
COMPOSITE CANS			7	1.92	5	3.73							12	3.05
			80.49		19.51								100	
			6.47		12.83								6.05	
OTHER CANS			4	7.72	1	0							5	7.36
			98.59		1.41								100	
			7.16		0.84								5.46	
CAPS, TOPS, LIDS			13	17.17	17	21.85	120	2.88	1	24.38			151	2.48
			32.06		23.29		44.16		0.60				100	
			4.25		26.29		48.19		2.01				9.98	
TOTAL CAN-RELATED MAGNETICS	1	0.66	105	11.62	40	11.40	121	3.96	1	24.38			268	11.70
	2.83		84.48		6.40		5.73		0.96				100	
	100		89.80		60.90		50.06		2.01				79.95	
TOTAL NON-CAN MAGNETICS			5	20.68	7	28.89	25	0.79	50	2.12	96	0.57	181	6.05
			38.27		18.83		22.79		12.22		8.89		100	
			10.20		40.09		49.90		97.99		100		20.05	
TOTAL	1	0.65	110	12.60	47	31.30	146	2.87	51	2.76	96	0.57	449	11.57
	2.26		79.22		9.19		9.16		2.80		1.68		100	
	100		100		100		100		100		100		100	

NO. OF PARTICLES → ← # ATTACHED CONTAMINATION OF MAGNETICS
COMPOSITION OF SIZE RANGE ↓ → % OF COMPONENT IN SIZE RANGE (WT. %, AIR-DRY BASIS)

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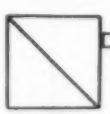
TABLE B-9. COMPOSITION/PARTICLE-SIZE DISTRIBUTION OF MAGNETIC PRODUCT

TEST No.: 4.01
DATE: 4 Oct. '78
RUN No.: 2
SAMPLE: MDS PRODUCT

SAMPLE WT., WET: 5.6458 kg (12.4446 lb)
BULK DENSITY, WET WT.: 12.76 lb/ft³
TIME COMPONENTS AIR DRIED: 6 days
TIME COMPONENTS SCREENED: 10 min.
TOTAL WT. SCREENED, AIR DRY: 5.4017 kg (11.9085 lb)

COMPONENT (AIR DRY LOSS, WET BASIS)	SIEVE-SIZE RANGE						
	+4 in.	-4+2	-2+1	-1+0.5	-0.5+0.25	-0.25	TOTAL
PAPER PRODUCTS (42.81%)		5.80 0.05	79.83 8.06	12.98 1.07	1.38 0.49	— —	100 0.67
YARD WASTE (85.56%)					100 0.39	— —	100 0.01
PLASTICS (42.55%)		85.19 0.05			14.81 0.39	— —	100 0.05
OTHER HEAVY ORGANICS —						— —	0 0
FERROUS (3.84%)	2.70 100	79.97 99.90	6.17 91.95	8.06 97.78	1.74 92.10	1.35 96.92	100 99.01
ALUMINUM —						— —	0 0
OTHER NON-FERROUS —						— —	0 0
GLASS 0				48.57 1.16	51.43 5.33	— —	100 0.19
STONES & CERAMICS (13.32%)					100 1.28	— —	100 0.02
-.025 in. FINES (28.13%)	— —	— —	— —	— —	— —	100 3.08	100 0.04
TOTAL (4.32%)	2.67 100	79.27 100	6.65 100	8.16 100	1.88 100	1.38 100	100 100



% OF COMPONENT IN SIZE RANGE (wt. %, air-dry basis)

COMPOSITION OF SIZE RANGE

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TABLE B-10. COMPOSITION/PARTICLE-SIZE DISTRIBUTION OF MAGNETICS IN PRODUCT

TEST No.: 4.01
DATE: 4 OCT. '78
RUN No.: 2
SAMPLE: MDS PRODUCT MAGNETICS (FERROUS)

SAMPLE WT., WET: 5.5617 Kg (12.2612 lb)
TOTAL WT. SCREENED, AIR DRY: 5.3483 Kg (11.7908 lb)

COMPONENT (AIR DRY LOSS, WET BASIS)	SIEVE-SIZE RANGE						
	+4 in.	-4+2	-2+1	-1+0.5	-0.5+0.25	-0.25	TOTAL
BIMETALLIC CANS (3.19%)		23 | 2.00 100 24.93					23 | 2.00 100 19.94
TIN-PLATED STEEL FOOD CANS (5.87%)	1 | 0.55 6.53 100	57 | 7.41 89.33 54.45	17 | 5.93 4.73 37.31	1 | 21.30 0.41 2.51			76 | 7.02 100 48.75
COMPOSITE CANS (5.00%)			1 | 19.74 100 2.30				1 | 19.74 100 0.14
OTHER CANS (0.99%)		3 | 8.12 98.47 7.37	1 | 0 1.53 1.48				4 | 8.00 100 5.99
CAPS, TOPS, LIDS (0%)		11 | 18.18 40.52 4.15	11 | 13.76 21.21 28.16	69 | 3.28 37.54 38.20	1 | 34.38 0.73 3.43		92 | 11.77 100 8.20
TOTAL CAN-RELATED MAGNETICS (4.34%)	1 | 0.55 3.25 100	94 | 6.48 87.58 90.91	30 | 9.44 5.15 69.26	70 | 4.39 3.96 40.71	1 | 34.38 0.07 3.43		196 | 6.37 100 83.02
TOTAL NON-CAN MAGNETICS (1.30%)		3 | 3.16 42.81 9.09	3 | 37.06 11.17 30.74	18 | 0.90 28.13 59.29	26 | 2.44 9.92 96.57	28 | 0.56 7.97 100	78 | 6.03 100 16.98
TOTAL (3.84%)	1 | 0.55 2.70 100	97 | 6.17 79.97 100	33 | 7.93 6.17 100	88 | 2.32 8.06 100	27 | 3.54 1.74 100	28 | 0.55 1.35 100	274 | 6.32 100 100

No. of Particles ⇦ ⇨ % Attached Contamination of Magnetics
Composition of Size Range ⇩ ⇨ % of Component in Size Range (wt. %, air-dry basis)

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TABLE B-11: MDS RECOVERY: CLEAN-METAL BASIS

TEST No.: 4.01
DATE: 4 OCT. '78
RUN No.: 2

COMPONENT	SIEVE-SIZE RANGE																					
	+4 in.				-4+2				-2+1				-1+0.5				-0.5+0.25				-0.25				TOTAL			
BIMETALLIC CANS					95.83	100																			95.83	100		
					96.51																				95.51			
TIN-PLATED STEEL FOOD CANS	100	100			100	100			100	100			100	100											100	100		
	100				100				100				100												100			
COMPOSITE CANS					0	0			20.0	3.79															8.33	0.53		
					0				17.18																6.11			
OTHER CANS					75.0	100			100	-															80.0	100		
					91.24				100																91.38			
CAPS, TOPS, LIDS					84.62	92.29			64.71	36.24			57.50	58.70			100	100							60.93	66.02		
					86.14				71.16				58.64				100								69.70			
TOTAL CAN-RELATED MAGNETICS	100	100			89.62	50.3			76.0	26.28			57.85	66.96			100	100							73.13	47.52		
	100				95.67				76.99				59.89				100								92.46			
TOTAL NON-CAN MAGNETICS					60.0	12.47			42.86	37.49			72.0	100			52.0	66.67			79.79	100			49.09	26.73		
					96.51				47.79				87.70				57.56				67.42				79.62			
TOTAL	100	100			88.18	49.12			70.21	32.42			60.27	72.46			52.94	75.0			29.79	100			61.02	42.19		
	100				96.75				67.30				74.01				58.14				67.42				89.99			

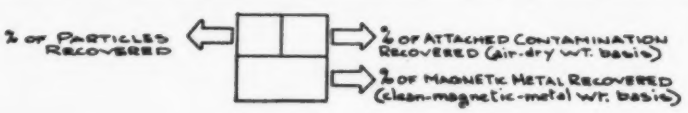
% OF PARTICLES RECOVERED
% OF ATTACHED CONTAMINATION RECOVERED (air-dry wt. basis)
% OF MAGNETIC METAL RECOVERED (clean-magnetic-metal wt. basis)

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TABLE B-12: MDS RECOVERY: AIR-DRIED BASIS

TEST NO.: 4.01
DATE: 4 OCT 78
RUN NO.: 2

COMPONENT	SIEVE-SIZE RANGE						
	+4 in.	-4+2	-2+1	-1+0.5	-0.5+0.25	-0.25	TOTAL
BIMETALLIC CANS							
		95.60					95.60
TIN-PLATED STEEL FOOD CANS							
	100	100	100	100			100
COMPOSITE CANS							
		0	10.12				1.97
OTHER CANS							
		91.9	0				92.01
CAPS, TOPS, LIDS							
		87.19	62.84	58.64	100		68.98
TOTAL CAN-RELATED MAGNETICS							
	100	90.40	65.12	60.17	100		87.20
TOTAL NON-CAN MAGNETICS							
		79.56	43.36	87.8	57.76	67.54	71.13
TOTAL							
	100	89.29	56.42	73.97	87.03	67.54	83.98

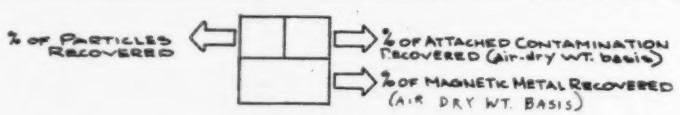
% OF PARTICLES RECOVERED
% OF ATTACHED CONTAMINATION RECOVERED (air-dry WT. basis)
% OF MAGNETIC METAL RECOVERED (AIR DRY WT. BASIS)

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TABLE B-13. COMPOSITION/PARTICLE-SIZE DISTRIBUTION OF MAGNETICS IN TAILINGS

TEST No.: 4.01
DATE: 4 Oct. '78
RUN No.: 2
SAMPLE: Residual Magnetics (in MDS Tailings)

Sample wt., wet: 1.1083 Kg (2.443316)
Bulk density, wet wt.: 14.12 lb/ft³
Time air dried: 3 days
Air dry loss, wet-wt. basis: 7.95%
Time screened: 20 min.
Sample wt. screened, air dry: 1.0202 Kg (2.2491 lb)

Component	Sieve-size range															
	+4 in.		-4+2		-2+1		-1+0.5		-0.5+0.25		-0.25		Total	
Bimetallic cans			1	0									1	0
			100										100	
			9.57										4.81	
Tin-plated steel food cans													0	-
													0	
													0	
Composite cans			7	30.38	4	56.44							11	75.16
			82.11		17.89								100	
			60.43		26.46								36.99	
Other cans			1	0									1	0
			100										100	
			5.42										2.72	
Caps, tops lids			2	10.34	6	40.91	51	3.27					59	14.71
			13.24		27.89		58.87						100	
			5.09		21.56		76.58						19.33	
Total can-related magnetics			11	60.11	10	49.47	51	3.27					72	47.98
			63.38		18.80		17.82						100	
			80.62		48.02		76.58						63.86	
All magnetic non-can							7	0	18	0	61	0	86	0
							26.59		48.01		35.39		100	
							23.42		97.27		97.41		13.009	
Composite non-can magnetics			2	86.39	4	47.36			6	61.11	5	0	17	63.86
			42.47		56.38				0.77		0.38		100	
			19.48		51.98				2.73		2.59		23.05	
Total non-can magnetics			2	86.39	4	47.36	7	0	24	1.67	66	0	103	40.24
			27.10		35.96		9.63		17.87		9.44		100	
			19.48		51.98		23.42		100		100		36.14	
TOTAL			13	65.23	14	48.37	58	2.51	24	1.67	66	0	175	45.36
			50.26		25.00		14.86		6.46		3.41		100	
			100		100		100		100		100		100	

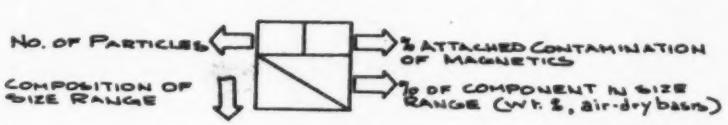
No. of Particles
% Attached Contamination of Magnetics
Composition of size range
% of component in size range (wt. %, air-dry basis)

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TABLE B-14. COMPOSITION/PARTICLE-SIZE DISTRIBUTION OF MAGNETICS IN FEED

TEST NO.: 4.01
DATE: 4 OCT. '78
RUN NO.: 3
SAMPLE: MAGNETICS IN MDS FEED COMPOSITE

SAMPLE WT., WET: 9.1226 Kg (20.1116 lb)
AIR DRY LOSS, WET-WT. BASIS: 4.13 %
SAMPLE WT. SCREENED, AIR-DRY: 8.7461 Kg (19.2815 lb)

COMPONENT	SIEVE-SIZE RANGE													
	+4 in.		-4+2		-2+1		-1+0.5		-0.5+0.25		-0.25		TOTAL	
BIMETALLIC CANS			31	1.69									31	1.69
			100										100	
			21.73										16.05	
TIN-PLATED STEEL FOOD CANS			56	16.48	24	3.53	1	61.19	3	40.69	2	0	86	15.79
			93.17		6.30		0.11		0.40		0.01		100	
			44.21		16.22		0.45		5.83		0.31		35.02	
COMPOSITE CANS			4	63.36									4	63.36
			100										100	
			1.81										1.34	
OTHER CANS			2	20.26									2	20.26
			100										100	
			2.11										1.56	
CAPS, TOPS, LIDS			12	55.0	24	22.19	135	3.10					171	30.49
			46.23		21.05		33.72						100	
			6.49		16.38		42.05						10.60	
TOTAL CAN-RELATED MAGNETICS			105	16.76	48	12.91	136	3.61	3	40.69	2	0	294	15.81
			87.30		6.87		5.59		0.22		0.01		100	
			76.35		32.60		42.50		5.83		0.31		64.53	
TOTAL NON-CAN MAGNETICS			6	29.49	17	22.09	46	9.22	55	3.22	138	0.29	262	21.34
			49.31		25.92		13.80		6.47		4.50		100	
			23.65		67.40		57.50		94.17		99.69		35.42	
TOTAL			111	19.76	65	19.09	182	6.84	58	5.40	140	0.29	556	17.91
			73.85		13.62		8.50		2.44		1.60		100	
			100		100		100		100		100		100	

No. of Particles ⇐ ⇒ % Attached Contamination of Magnetics
Composition of Size Range ⇓ ⇒ % of Component in Size Range (wt. %, air-dry basis)

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TABLE B-15. COMPOSITION/PARTICLE-SIZE DISTRIBUTION OF MAGNETIC PRODUCT

TEST No.: 4.01
DATE: 4 Oct. '78
RUN No.: 3
SAMPLE: MDS PRODUCT

SAMPLE WT., WET: 8.01 Kg (17.66 lb)
BULK DENSITY, WET WT.: 13.30 lb/ft³
TIME COMPONENTS AIR DRIED: 6 days
TIME COMPONENTS SCREENED: 10 min.
TOTAL WT. SCREENED, AIR DRY: 7.6046 Kg (16.7690 lb)

COMPONENT (AIR DRY LOSS, WET BASIS)	SIEVE-SIZE RANGE						
	+4 in.	-4+2	-2+1	-1+0.5	-0.5+0.25	-0.25	TOTAL
PAPER PRODUCTS (37.19%)	35.25 / 75.75	44.06 / 0.76	17.90 / 1.94	1.77 / 0.31	1.02 / 0.66	— / —	100 / 1.32
YARD WASTE (56.0%)	2.26 / 0.11	/	8.14 / 0.02	51.13 / 0.20	38.46 / 0.55	— / —	100 / 0.03
PLASTICS (23.60%)	100 / 24.14	/	/	/	/	— / —	100 / 0.15
OTHER HEAVY ORGANICS (32.01%)	/	95.06 / 0.42	/	4.94 / 0.22	/	— / —	100 / 0.34
FERROUS (4.21%)	/	76.77 / 98.81	12.20 / 98.04	7.62 / 98.94	2.05 / 98.79	1.36 / 100	100 / 98.14
ALUMINUM —	/	/	/	/	/	— / —	0 / 0
OTHER NON-FERROUS —	/	/	/	/	/	— / —	0 / 0
GLASS 0	/	/	/	100 / 0.53	/	— / —	100 / 0.02
STONES & CERAMICS —	/	/	/	/	/	— / —	0 / 0
-.025 in FINES —	— / —	— / —	— / —	— / —	— / —	0 / 0	0 / 0
TOTAL (5.06%)	0.61 / 100	76.24 / 100	12.21 / 100	7.56 / 100	2.03 / 100	1.34 / 100	100 / 100

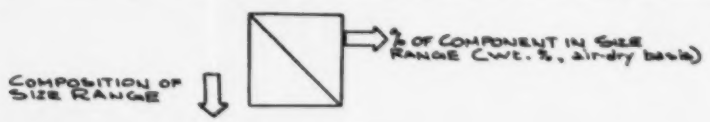

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TABLE B-16. COMPOSITION/PARTICLE-SIZE DISTRIBUTION OF MAGNETICS IN PRODUCT

TEST No.: 4.01
DATE: 4 OCT. '78
RUN No.: 3
SAMPLE WT., WET: 7.7907 kg (17.1763 lb)
TOTAL WT. SCREENED, AIR DRY: 7.4630 kg (16.4528 lb)
SAMPLE: MDS PRODUCT MAGNETICS (FERROUS)

COMPONENT (AIR DRY LOSS, WET BASIS)	SIEVE-SIZE RANGE						
	+4 in.	-4+2	-2+1	-1+0.5	-0.5+0.25	-0.25	TOTAL
BIMETALLIC CANS (2.99%)		31 | 1.69					31 | 1.69
		100					100
		24.50					18.81
TIN-PLATED STEEL FOOD CANS (6.64%)		55 | 16.52	20 | 4.25	1 | 51.19	3 | 40.69	2 | 0	81 | 16.0
		94.17	5.29	0.11	0.41	0.01	100
		49.69	17.58	0.59	8.12	0.42	40.51
COMPOSITE CANS (12.16%)		2 | 66.12					2 | 66.12
		100					100
		1.07					0.82
OTHER CANS (2.16%)		2 | 20.26					2 | 20.26
		100					100
		2.38					1.83
CAPS, TOPS, LIDS (3.95%)		7 | 7.97	19 | 7.62	84 | 2.34			110 | 5.61
		30.81	29.01	40.17			100
		2.63	15.58	34.51			6.54
TOTAL CAN-RELATED MAGNETICS (5.37%)		97 | 12.49	39 | 5.84	85 | 3.17	3 | 42.69	2 | 0	226 | 11.80
		89.94	5.90	3.90	0.24	0.01	100
		80.27	33.14	35.10	8.12	0.42	68.51
TOTAL NON-CAN MAGNETICS (1.58%)		4 | 5.23	11 | 9.92	28 | 9.95	31 | 1.32	82 | 0.40	156 | 6.75
		48.11	26.40	15.70	5.98	4.31	100
		19.73	66.86	64.90	91.88	99.58	31.49
TOTAL (4.21%)		101 | 11.06	50 | 8.57	113 | 7.57	34 | 4.51	84 | 0.39	382 | 10.21
		76.77	12.20	7.62	2.05	1.36	100
		100	100	100	100	100	100

No. of Particles ⇐ ⇒ % Attached Contamination of Magnetics
Composition of Size Range ⇓ ⇒ % of Component in Size Range (wt. %, air-dry basis)

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TABLE B-17. MDS RECOVERY: CLEAN-METAL BASIS

TEST No.: 4.01
DATE: 4 OCT. '78
RUN No.: 3

COMPONENT	SIEVE-SIZE RANGE										TOTAL	
	+4 in.		-4+2		-2+1		-1+0.5		-0.5+0.25		-0.25			
BIMETALLIC CANS			100	100									100	100
			100										100	
TIN-PLATED STEEL FOOD CANS			92.81	100	82.32	100	100	100	100	100	100	—	96.49	100
			99.66		82.24		100		100		100		98.41	
COMPOSITE CANS			50.0	54.72									50.0	54.72
			48.48										48.48	
OTHER CANS			100	100									100	100
			100										100	
CAPS, TOPS, LIDS			58.33	6.20	79.17	24.94	62.22	47.42					68.33	9.66
			73.40		86.23		63.26						71.65	
TOTAL CAN-RELATED MAGNETICS			92.58	49.48	81.25	56.14	62.50	56.34	100	100	100	—	82.07	67.55
			98.04		84.03		63.45		100		100		94.84	
TOTAL NON-CAN MAGNETICS			66.67	13.15	66.71	34.07	60.87	93.15	56.34	28.48	59.42	100	59.56	23.54
			99.42		87.66		85.64		71.41		72.57		90.40	
TOTAL			90.99	49.63	76.92	34.31	62.09	89.46	58.62	60.0	60.0	100	68.71	28.63
			98.32		86.39		75.89		72.45		72.65		93.34	

% OF PARTICLES RECOVERED

% OF ATTACHED CONTAMINATION RECOVERED (air-dry wt. basis)

% OF MAGNETIC METAL RECOVERED (clean-magnetic-metal wt. basis)

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TABLE B-18. MDS RECOVERY: AIR-DRIED BASIS

TEST No.: #.01
DATE: 4 Oct 78
RUN No.: 3

COMPONENT	SIEVE-SIZE RANGE						
	+2 in.	-2+2	-2+1	-1+0.5	-0.5+0.25	-0.25	TOTAL
BIMETALLIC CANS							
		100					100
TIN-PLATED STEEL FOOD CANS							
		99.72	82.87	100	100	100	98.66
COMPOSITE CANS							
		52.43					52.43
OTHER CANS							
		100					100
CAPS, TOPS, LIDS							
		35.89	72.63	62.76			52.69
TOTAL CAN-RELATED MAGNETICS							
		93.26	77.72	63.16	100	100	90.52
TOTAL NON-CAN MAGNETICS							
		74.01	75.82	86.34	70.09	72.65	75.86
TOTAL							
		88.71	76.84	76.99	71.78	72.73	85.33

% OF PARTICLES RECOVERED
% OF ATTACHED CONTAMINATION RECOVERED (AIR-DRY WT. BASIS)
% OF MAGNETIC METAL RECOVERED (AIR-DRY WT. BASIS)

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TABLE B-19. COMPOSITION/PARTICLE-SIZE DISTRIBUTION OF MAGNETICS IN TAILINGS

TEST No: 4.01
DATE: 4 Oct. '78
RUN No: 3
SAMPLE: RESIDUAL MAGNETICS (IN MDS TAILINGS)

SAMPLE WT., WET: 1.3319 Kg (2.9363 lb)
BULK DENSITY, WET WT: 21.05 lb/ft³
TIME AIR DRIED: 3 days
AIR DRY LOSS, WET-WT. BASIS: 3.66%
TIME SCREENED: 20 min.
SAMPLE WT. SCREENED, AIR DRY: 1.2881 Kg (2.8287 lb)

COMPONENT	SIEVE-SIZE RANGE														TOTAL	
	+4 in.		-4+2		-2+1		-1+0.5		-0.5+0.25		-0.25					
BIMETALLIC CANS													0	-		
															0	
													0			
TIN-PLATED STEEL FOOD CANS			1	0	4	0							5	0		
				19.40		80.64									100	
			1.10		11.80										3.20	
COMPOSITE CANS			2	100									2	100		
			7.64												4.54	
OTHER CANS													0	-		
															0	
													0			
CAPS, TOPS LIDS			5	81.29	5	12.18	51	26.54					61	58.41		
			36.85		19.23		66.69								34.18	
TOTAL CAN-RELATED MAGNETICS			8	62.10	9	16.16	51	21.74					68	41.13		
			46.68		30.82		66.59								41.73	
ALL MAGNETIC NON-CAN					2	0	12	2.03	16	0	52	0	82	0.51		
					25.76		25.14		24.81		17.29				100	
					26.12		30.96		88.85		97.64				16.77	
COMPOSITE NON-CAN MAGNETICS			2	98.41	4	99.88	6	37.21	8	68.44	4	0	24	99.99		
				38.55		23.21		0.81		1.26		0.17			100	
			51.42		44.05		2.46		11.15		2.36				41.50	
TOTAL NON-CAN MAGNETICS			2	98.41	6	100.23	18	44.2	24	76.5	56	0	106	100.84		
				53.10		26.96		7.81		8.04		5.10			100	
			51.42		69.17		73.41		100		100				58.27	
TOTAL			10	100.13	15	53.24	69	4.44	24	7.65	56	0	174	62.72		
				56.85		21.87		15.62		4.68		2.97			100	
			100		100		100		100		100				100	

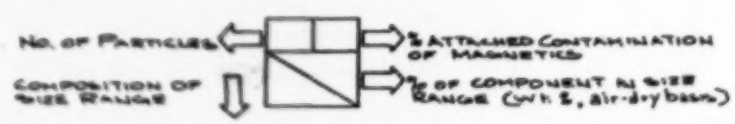
NO. OF PARTICLES
COMPOSITION OF SIZE RANGE
% ATTACHED CONTAMINATION OF MAGNETICS
% OF COMPONENT IN SIZE RANGE (WT. %, air-dry basis)

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TABLE B-20. COMPOSITION/PARTICLE-SIZE DISTRIBUTION OF MAGNETICS IN FEED

TEST No: 4.01
DATE: 4 Oct. '78
RUN No.: Composite of Runs 1, 2 & 3
SAMPLE: Magnetics in MDS Feed (Composite)

SAMPLE WT., WET: 28.1737 kg (62.1175 lb)
AIR DRY LOSS, WET-WT. BASIS: 8.97 %
SAMPLE WT. SCREENED, AIR-DRIED: 24.1760 kg (53.2959 lb)

COMPONENT	SIEVE-SIZE RANGE														TOTAL	
	+4 in.		-4+2		-2+1		-1+0.5		-0.5+0.25		-0.25					
BIMETALLIC CANS			76	1.60											79	1.60
			100												100	
			20.82												15.00	
TIN-PLATED STEEL FOOD CANS	1	0.55	184	12.81	66	5.21	7	0.49	1	0.07	2	0			260	12.26
	1.81		92.69		5.62		0.15		0.13		0.005				100	
	47.05		50.77		17.42		0.87		2.29		0.12				39.51	
COMPOSITE CANS			15	72.46	6	6.273									20	70.98
			87.68		12.37										100	
			3.05		2.44										2.51	
OTHER CANS			10	6.32	1	0									11	6.24
			99.43		0.57										100	
			4.89		0.16										3.56	
CAPS, TOPS, LIDS			41	32.92	92	25.13	449	7.53	2	12.22					584	9.15
			32.78		29.55		57.55		0.83						100	
			5.18		28.22		41.79		1.66						11.89	
TOTAL CAN-RELATED MAGNETICS	1	0.55	329	13.10	164	18.99	461	2.88	5	29.72	2	0			962	2.86
	0.83		84.83		8.19		6.02		0.12		0.002				100	
	47.05		84.72		46.24		42.36		3.95		0.12				71.96	
TOTAL NON-CAN MAGNETICS	1	6.91	13	21.89	55	27.32	144	7.27	208	29.3	33	0.87			751	17.17
	2.39		39.25		24.43		21.02		7.68		5.22				100	
	52.95		15.28		53.76		57.64		96.05		99.88				28.08	
TOTAL	2	33.57	342	14.48	217	20.09	596	5.41	218	3.47	314	0.57	1783	11.98		
	1.27		72.05		13.75		10.83		2.24		1.47				100	
	100		100		100		100		100		100					

No. of Particles → ; ↓ Composition of Size Range
→ % Attached Contamination of Magnetics
→ % of Component in Size Range (wt. %, air-dry basis)

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TABLE B-21. COMPOSITION/PARTICLE-SIZE DISTRIBUTION OF MAGNETIC PRODUCT

TEST NO: 4.01
DATE: 4 OCT. '78
RUN NO: COMPOSITE OF RUNS: 1,2 & 3
SAMPLE: MDG PRODUCT

SAMPLE WT., WET: 21.4658 kg (47.3225 lb)
BULK DENSITY, WET WT.: 12.63 lb/ft³
TIME COMPONENTS ARE DRIED: 6 days
TIME COMPONENTS SCREENED: 10 min.
TOTAL WT. SCREENED, AS REC'D: 20.5247 kg (45.2488 lb)

COMPONENT (AS DRY LOSS, WET BASIS)	SIEVE-SIZE RANGE						
	+4 in.	-4+2	-2+1	-1+0.5	-0.5+0.25	-0.25	TOTAL
PAPER PRODUCTS (33.84 %)	19.09 / 20.40	37.12 / 0.81	38.82 / 3.70	4.38 / 0.81	0.90 / 0.50	— / —	100 / 1.04
YARD WASTE (47.92 %)	1.25 / 0.02		9.48 / 0.02	45.64 / 0.10	43.64 / 0.46	— / —	100 / 0.02
PLASTICS (24.63%)	88.69 / 7.67	12.81 / 0.01		1.63 / 0.02	2.18 / 0.10	— / —	100 / 0.09
OTHER HEAVY ORGANICS (26.86%)		72.93 / 0.16	22.09 / 0.33	3.79 / 0.07	1.19 / 0.10	— / —	100 / 0.16
FERROUS (3.84%)	0.71 / 71.90	26.68 / 99.82	10.60 / 96.96	9.05 / 98.98	1.82 / 96.70	1.14 / 97.05	100 / 98.58
ALUMINUM —						— / —	0 / 0
OTHER NON-FERROUS —						— / —	0 / 0
GLASS 0%				50.72 / 0.38	49.28 / 1.78	— / —	100 / 0.07
STONES & CERAMICS (13.33%)					100 / 0.34	— / —	100 / 0.01
-.025 in. FINES (31.37%)	— / —	— / —	— / —	— / —	— / —	100 / 2.95	100 / 0.08
TOTAL (4.38%)	0.98 / 100	26.11 / 100	10.89 / 100	9.01 / 100	1.86 / 100	1.15 / 100	100 / 100

% OF COMPONENT IN SIZE RANGE (WT. %, AS-DRY BASIS)
COMPOSITION OF SIZE RANGE

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TABLE B-22. COMPOSITION/PARTICLE-SIZE DISTRIBUTION OF MAGNETICS IN PRODUCT

TEST No.: 4.01
DATE: 4 OCT. '78
RUN No.: COMPOSITE OF RUNS 1,2 & 3
SAMPLE: MSW PRODUCT MAGNETICS (FERROUS)
SAMPLE WT., WET: 10.9408 kg (24.10 lb)
TOTAL WT. SCREENED, AIR DRIED: 20.2528 kg (44.609 lb)

COMPONENT	SIEVE-SIZE RANGE													
	+6 in.		-6+2		-2+1		-1+0.5		-0.5+0.25		-0.25		TOTAL	
BIMETALLIC CANS (2.68%)			76	1.66									76	1.66
			100										100	
			22.49										17.21	
TIN-PLATED STEEL FOOD CANS (9.84%)	1	0.55	180	0.82	61	3.42	2	0.11	3	0.17	2	0	249	5.44
	1.87		92.70		6.44		0.18		0.18		0.008		100	
	100		54.94		23.35		0.77		5.54		0.19		45.45	
COMPOSITE CANS (11.42%)			2	0.11	1	0.06							3	0.17
			66.67		11.01								100	
			0.40		0.35								0.54	
OTHER CANS (1.11%)			9	0.54	1	0							10	0.54
			99.41		0.69								100	
			5.33		0.24								1.10	
CAPS, TOPS, LIDS (2.80%)			31	1.81	61	3.59	26	1.53	1	0.06			119	7.00
			26.05		51.70		22.86		0.84				100	
			18.35		22.96		13.88		0.87				16.16	
TOTAL CAN-RELATED MAGNETICS (4.59%)	1	0.06	298	6.48	124	7.05	266	2.86	4	0.23	2	0	695	16.17
	0.96		88.26		6.60		4.10		0.10		0.008		100	
	100		76.65		46.85		44.10		4.28		0.19		75.29	
TOTAL NON-CAN MAGNETICS (1.50%)			8	0.53	81	3.71	88	4.16	94	1.34	46	0.67	369	9.57
			41.42		22.80		24.12		7.07		4.69		100	
			13.35		53.15		65.90		26.77		99.81		24.71	
TOTAL (3.84%)	1	0.06	306	7.02	205	10.76	354	7.02	98	2.95	48	0.67	1064	28.23
	0.71		76.68		10.80		9.05		1.82		1.14		100	
	100		100		100		100		100		100		100	

No. of Particles → ← % Attached Contamination of Magnetics
Composition of Size Range ↓ → % Component in Size Range (wt. %, air-dry basis)

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TABLE B-23. MDS RECOVERY: CLEAN-METAL BASIS

TEST NO.: 4.01
DATE: 4 OCT. '78
RUN NO.: COMPOSITE OF RUNS 1, 2 & 3

COMPONENT	SIEVE-SIZE RANGE												TOTAL	
	+4 in.		-4+2		-2+1		-1+0.5		-0.5+0.25		-0.25			
BIMETALLIC CANS			[illegible]	100									[illegible]	100
			95.94										95.94	
TIN-PLATED STEEL FOOD CANS	100	100	[illegible]	[illegible]	[illegible]	100	100	100	100	100	100	-	[illegible]	[illegible]
	100		98.60		92.82		100		100		100		98.27	
COMPOSITE CANS			13.33	10.58	20.00	3.79							15.00	9.77
			14.79		17.18								15.28	
OTHER CANS			90.00	100	100	-							90.91	100
			96.52		100								96.54	
CAPS, TOPS, LIDS			[illegible]	21.95	66.30	25.18	58.57	[illegible]	50.00	100			[illegible]	[illegible]
			80.24		72.86		59.20		26.58				68.52	
TOTAL CAN-RELATED MAGNETICS	100	100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100	100	-	[illegible]	[illegible]
	100		95.94		80.06		59.60		61.99		100		92.80	
TOTAL NON-CAN MAGNETICS	0	0	11.64	12.73	[illegible]	[illegible]	61.11	[illegible]	[illegible]	[illegible]	[illegible]	100	[illegible]	19.65
	0		95.76		80.86		87.47		68.43		64.71		84.97	
TOTAL	[illegible]	0.18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100	[illegible]	[illegible]
	70.43		96.92		80.38		76.95		68.44		64.75		90.32	

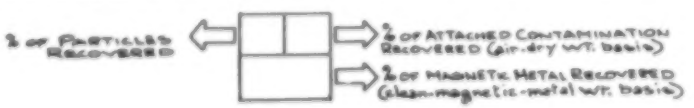
% OF PARTICLES RECOVERED
% OF ATTACHED CONTAMINATION RECOVERED (air-dry WT. basis)
% OF MAGNETIC METAL RECOVERED (clean-magnetic-metal WT. basis)

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TABLE B-24. MDS RECOVERY: AIR-DRIED BASIS

TEST NO.: 4.01

DATE: 4 Oct 78

RUN NO.: Composite of Runs 1, 2, & 3

COMPONENT	SIEVE-SIZE RANGE						
	+6 in.	-6+2	-2+1	-1+0.5	-0.5+0.25	-0.25	TOTAL
BIMETALLIC CANS		96.00					96.00
TIN-PLATED STEEL FOOD CANS	100	96.39	93.20	100	100	100	96.28
COMPOSITE CANS		11.55	10.12				11.37
OTHER CANS		96.74	100				96.76
CAPS, TOPS, LIDS		72.80	60.88	59.04	35.56		60.16
TOTAL CAN-RELATED MAGNETICS	100	91.10	70.52	59.59	72.91	100	87.57
TOTAL NON-CAN MAGNETICS	0	77.83	68.80	84.62	67.88	64.84	73.75
TOTAL	47.05	89.07	69.60	74.02	68.07	64.88	83.69

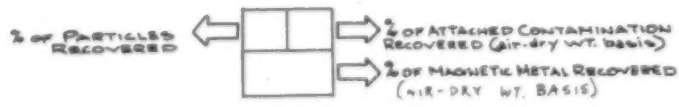
% OF PARTICLES RECOVERED
% OF ATTACHED CONTAMINATION RECOVERED (air-dry WT. BASIS)
% OF MAGNETIC METAL RECOVERED (AIR-DRY WT. BASIS)

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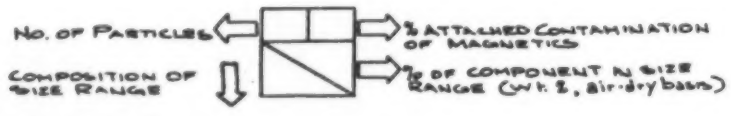
TABLE B-25. COMPOSITION/PARTICLE-SIZE DISTRIBUTION OF MAGNETICS IN TAILINGS

TEST No: 4.01
DATE: 4 OCT. '78
RUN NO.: COMPOSITE OF RUNS 1, 2 & 3
SAMPLE: RESIDUAL MAGNETICS (IN MDS TAILINGS)

SAMPLE WT., WET: 4.1329 kg (9.1113 lb)
BULK DENSITY, WET WT: 18.19 lb/ft³
TIME AIR DRIED: 3 days
AIR DRY LOSS, WET-WT. BASIS: 4.60%
TIME SCREENED: 20 min.
SAMPLE WT. SCREENED, AIR DRY: 3.9427 kg (8.6920 lb)

COMPONENT	SIEVE-SIZE RANGE						
	+4 in.	-4+2	-2+1	-1+0.5	-0.5+0.25	-0.25	TOTAL
BIMETALLIC CANS		3 | 0					3 | 0
		100 / 7.61					100 / 3.68
TIN-PLATED STEEL FOOD CANS		4 | 66.13	5 | 0				9 | 59.55
		89.74 / 16.77	10.26 / 3.90				100 / 9.02
COMPOSITE CANS		13 | 79.53	4 | 56.44				17 | 72.26
		87.45 / 24.71	12.55 / 7.21				100 / 13.64
OTHER CANS		1 | 0					1 | 0
		100 / 1.46					100 / 0.71
CAPS, TOPS LIDS		10 | 65.96	31 | 48.04	186 | 2.91	1 | 0		228 | 36.11
		52.05 / 18.46	28.82 / 33.73	38.60 / 65.88	0.53 / 3.35		100 / 27.81
TOTAL CAN-RELATED MAGNETICS		31 | 60.40	40 | 45.21	186 | 1.91	1 | 0		258 | 46.04
		60.74 / 69.01	19.42 / 44.83	19.57 / 65.88	0.27 / 3.35		100 / 54.86
ALL MAGNETIC NON-CAN			8 | 0	43 | 0.69	89 | 0	173 | 0	313 | 0.20
			21.90 / 13.01	28.46 / 24.65	27.69 / 89.08	21.94 / 98.07	100 / 14.11
COMPOSITE NON-CAN MAGNETICS	1 | 62.91	5 | 86.01	14 | 68.60	13 | 86.35	25 | 60.31	11 | 0	69 | 78.39
	13.27 / 100	48.22 / 30.99	32.28 / 42.15	4.97 / 9.46	1.07 / 7.57	0.20 / 1.93	100 / 31.03
TOTAL NON-CAN MAGNETICS	1 | 62.91	5 | 85.9	22 | 52.34	56 | 21.45	114 | 4.72	184 | 0	382 | 52.56
	9.12 / 100	33.14 / 30.99	29.04 / 55.17	12.32 / 34.12	9.39 / 96.65	6.99 / 100	100 / 45.14
TOTAL	1 | 62.91	36 | 68.03	62 | 49.16	242 | 10.26	115 | 4.59	184 | 0	640 | 48.98
	4.12 / 100	48.28 / 100	23.76 / 100	16.30 / 100	4.41 / 100	3.16 / 100	100 / 100


NO. OF PARTICLES
% ATTACHED CONTAMINATION OF MAGNETICS
COMPOSITION OF SIZE RANGE
% OF COMPONENT IN SIZE RANGE (WT. %, air-dry basis)

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June 1981

P881-213324

FERROUS METALS RECOVERY AT RECOVERY 1, NEW ORLEANS: PERFORMANCE OF THE MODIFIED SYSTEM

Test No. 4.05 & Test No. 4.09, Recovery 1, New Orleans

by

Perry Bagalman
National Center for Resource Recovery, Inc.
Washington, D. C. 20036

Contract No. 68-01-4423

Project Officer

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